

LECTURES ON ENTOMOLOGY.

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Coleoptera.

Lucanus Cervus. - (Stag Beetle.)

LECTURES

ON

ENTOMOLOGY.

BY

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ON ENTOMOLOGY.

First Lecture.

The numerous beings comprehended under the name of insects, offer to our regard so many interesting objects of contemplation and research, that their history has deservedly assumed a prominent place among the natural sciences; although not to be compared with many other animals in direct utility to man, they are by no means destitute even of the interest produced by that consideration, while they possess advantages as a subject of study and investigation equal to any other branch of zoology. Such is the extent of the subject and the variety of aspects in which it may be viewed, that minds of very different tastes and capacities may find congenial occupation in some one or other of its numerous details; even to the fine assortment of its colours, every thing seems on purpose to please the eye of man; each tribe of this extensive class of animals possesses peculiar attributes deserving of our regard. The extreme beauty of the (*Lepidoptera*) or Butterflies, the striking contrast they present in the different stages of their existence so remarkable, as to have caused them to be regarded by a mystical philosophy, as the types of the human soul released from its material incumbrance; their habits and times of appearance, the one suggesting the purity of an ethereal nature, the other associating them in the mind of the observer, with the beauty of external nature, and the genial influence of the seasons, have alike contributed to render them objects of general favour.

LINNÆUS has divided insects into seven orders: 1st.—the COLEOPTERA they are such as have crustaceous shells, which shut together and form a longitudinal suture down the back of the insect, as the *Stag Beetle*. 2nd.—HEMIPTERA have their upper wings, usually half crustaceous and half membraneous, not divided by a longitudinal suture, but incumbent on each other, as the (*Cimex*) or *Field Bug*. 3rd.—LEPIDOPTERA are insects having four wings covered with fine scales, in the form of powder, as in the *Butterfly*. 4th.—NEUROPTERA have four membraneous transparent naked wings, generally like net-work, as the *Dragon Fly*. 5th.—HYMENOPTERA are insects with four membraneous wings, tail furnished with a sting, as in the *Bee*. 6th.—DIPTERA are such as have only two wings and poisers, as the *Fly*. 7th.—APTERA having no wings. This last division contains *Scorpions*, *Spiders*, &c.

COLEOPTERA being the first order of insects and most numerous, I shall proceed to describe some of those belonging to this order: In this country alone, they amount by the latest and most accurate census to upwards of 3600, thus forming nearly a third part of our insect population; this is considerably more than double the number of flowering plants, indigenous to Britain, and greatly exceeds the whole amount of our native vertebrate animals. When compared with the two other orders, that are next to it in extent in this country, it will be found that the *Coleoptera* are nearly one half more numerous than the *Lepidoptera*, and that they stand much in relation to the *Diptera*, or two winged flies. And the whole amount of insects is about 30,000, that is 10,000 above the estimate formed by Ray, nearly a century and a half ago. The largest *Coleopterous* insects inhabiting Britain, are the *Hydrous Piceus* and the *Stag Beetle*, (*Lucanus Cervus*.) The latter is nearly two inches in length including the mandibles, and the former is not much short of the same dimensions, besides being of considerably greater breadth. These may be considered the giants of this order of insects, occupying one extremity of the scale. At the opposite extremity may be placed some species of the genera, *Trichopteryx*, *Atomaria*, and *Agathidium*, which are so minute as not to be larger than a full stop.

The STAG BEETLE occurs in considerable plenty, in several of the southern counties, but has not been observed in the north of England, nor in Scotland. The larva is considered to be the Cossus of the ancient Romans, which is described as a white worm living in the interior of oak trees, and which was much coveted as a delicious food by these refined epicures. The male is about two inches in length, including the mandibles; it is entirely of a brownish black colour, the surface shining, and thickly covered with small punctures. The female is considerably less, the mandibles are quite short, and the head is proportionally much smaller; Mr. Waterhouse relates that he kept a *Stag Beetle* alive for some weeks, he says, I allowed him to bite my finger with his mandibles, which he did with great strength, and perseverance for some seconds, and immediately on relaxing his hold, he applied alternately one of his antennæ to the indentation, as if to ascertain whether any moisture was flowing from the wound. The specimen which I had, became after a time tame and playful, sometimes amusing himself by tossing about a ball of cotton with his horns; he was very fond of sugar moistened and the juice of raspberries.

The most curious and interesting genius, which the order *Coleoptera* contains, is the NECROPHORUS or *Burying Beetle*. The females deposit their eggs in the decaying carcasses of moles, mice, and other small animals, which they previously bury for this purpose. To effect this operation, seemingly so disproportionate to their size and strength, two or three beetles generally unite their labours, and remove the earth from beneath the dead body, which gradually sinks into the excavation; during this process they may be seen dragging at the object from

below, and even mounting upon it as if to tread it into the grave. They labour at their task of inhumation, with the most unwearied industry. According to Mr. Gleditsh, who was the first to give an accurate account of the proceedings of these grave-diggers, four beetles were observed to inter in a very small space of earth to which they were confined; no fewer than twelve carcasses, few of which were inferior in size to a mole. The object of all this solicitude, is the security and comfort of their young; as the carcass, which forms a nidus for their eggs, if left exposed would run the risk of being devoured by beasts of prey, or the juices would be speedily evaporated by the heat of the sun, and the maggots thus deprived of their appropriate nourishment; the species amounts to nearly 30. They are almost invariably of a brownish black colour frequently variegated with spots of orange yellow, 7 different kinds, occur in Britain.

ATENOBUS SACER or SACRED EGYPTIAN BEETLE; this renowned insect has been singularly exempted, from the obscurity and neglect which have fallen to the lot of most of its tribe. It was one of those creeping things, to which the Egyptians paid divine honours, and appears to have constituted one of the favourite deities of that remarkable people. If it enjoyed an inferior degree of veneration to the snake-devouring Ibis; it certainly far surpassed in virtue the sacred leeks and onions, from which Juvenal takes occasion to congratulate the nation, on account of the number and dignity of its gods. It was consecrated to the sun, and representations of it are of frequent occurrence in their hieroglyphical writings, it was likewise sculptured on their rings, bracelets, necklaces, and other ornaments, and even inclosed in their coffins along with the embalmed bodies of the dead.

The CERAMBYX LONGIMANUS or HARLEQUIN BEETLE is remarkable for the length of its fore legs and its antennæ; this insect is of frequent occurrence in Brazil, Guiana, and other tropical countries of America. It is known to the natives, by the name of *Mouche Bagasse*, a term taken from a tree which has lately been described under the botanical appellation of *Bagassa Guyanensis*; the wood of this tree is of a bright yellow, and when it is felled there issues from it a white viscid juice of a peculiar and penetrating odour, of which the insects are so fond that they seldom fail to be attracted by it. The negroes, who often employ themselves in searching for the rarer and more beautiful kinds of insects, that they may dispose of them to collectors, avail themselves of this propensity, and sometimes cut down these trees as the most ready means of obtaining a supply of *Beetles*; it is generally found on the trunk, or at the bottom of trees, rarely under the bark and never on the leaves; its motions are so sluggish, that it may be said to drag itself along, rather than walk. It occasionally takes wing on the approach of evening; but its flight is slow and unsteady, scarcely appearing under the guidance of the animal, as it strikes against any

object that happens to be in the way, and falls to the ground ; it varies greatly in size and colour.

A very curious little insect is the DEATH WATCH (*Anobium Tessellatum*) ; which makes a ticking noise, like the beating of a watch. And it is believed by many people that, when the noise is heard, it is a sign of the death of some of their relations or friends. There are two species, one of a dark brown colour, having pellucid wings, a cap on the head, and two antennæ proceeding from beneath the eyes. The second kind is a small greyish insect, which is very nimble and sly ; the noise which it makes is a signal between the male and female.

THE BLISTER BEETLE or SPANISH FLY (*Meloe Vesecatorius*), is entirely of a golden green. In Spain, where they are in abundance, they are usually collected for commercial purposes in the month of June ; they are shaken from the branches of the shrubs which they frequent, and received in sheets spread on the ground, and are killed by being held in hair sieves over the fumes of vinegar, and afterwards dried ; either by exposure to the sun, or by being placed on hurdles covered with cloth or paper in a well ventilated apartment. The blistering property has been ascertained to reside in a peculiar principle, on which chemists have bestowed the name of *Cantharadine*.

The HYDROUS PICEUS or GREAT WATER BEETLE ; this is the largest aquatic *Beetle* inhabiting Britain. It is common in the southern parts of England, but becomes rare in the north ; and has not been observed in any part of Scotland. In its perfect state it is by no means so rapacious as the *Dytisci*, sometimes even feeding on vegetable substances ; but the larva is of such destructive and blood-thirsty propensities, that it is known in France by the name of ver-assassin. In that early condition it resembles a large soft worm, of a somewhat conical form, provided with six feet, and having its large scaly head armed with two formidable jaws. The head moves with such freedom in all directions, that it can readily seize small shell fish and molluscæ floating on the surface, without altering the horizontal position of the body maintained in swimming, and it is even bent backwards to devour its prey more conveniently, by using the back as a kind of support. The female *Beetle* spins a silken bag, (similar to that which may at any time be seen, attached to a dark coloured *Spider*, (*Lycosa Saccata*) of common occurrence under stones, and interesting for the maternal solicitude she shows in protecting her embryo progeny. In this receptacle they are left to swim about till they are hatched.

ELATER NOCTILUCUS (*The Fire Fly*). This insect is pretty widely distributed over the intertropical countries of South America, and the West Indian Islands. When it walks, or is at rest, the principal light which it emits issues from the two yellow tubercles placed at the lateral margins of the thorax ; but when the wings and elytra are expanded in the act of flight, another luminous spot is disclosed in the

hinder part of the thorax. This luminosity is so considerable, that it is often employed in the countries where it prevails, as a substitute for artificial lights. A single insect is sufficient to enable a person to decipher the smallest written character, and when several are brought together, their light is said to suffice for all the ordinary evening occupations of an Indian's dwelling. They are employed for many useful purposes, the Indians are said to have formerly used them instead of flambeaux in their hunting and fishing expeditions, and when travelling in the night they were accustomed to fasten them to their feet and hands. Another important service is rendered by these insects in destroying the gnats and musquitoes, which abound in tropical countries to the incessant annoyance of the inhabitants, like most other animals of nocturnal habits, the *fire-flies* are attracted by strong light, and the Indians obtain them for the purposes above mentioned. At Havannah they are collected and sold for ornamenting the ladies head-dresses at evening parties, when they are generally confined under gauze, which covers the head, and from among the ringlets of hair these terrestrial stars shine forth with all their beauty.

The TUMBLE DUNG BEETLES are so exceedingly strong and active, as to move about with the greatest ease things that are many times their own weight. Dr. Birchell was supping one evening in a planter's house, at North Carolina, when one was conveyed, without his knowledge, under the candlestick; a few blows were struck on the table and, to his great surprize, the candlestick began to move about, apparently without any agency; and his surprize was not much lessened when, on taking one of them up, he discovered that it was only a chafer that moved. An insect of the size of a *May Bug*, says another writer, evidently in relation to one of these beetles, is of the greatest utility in hot climates, it is the scavenger and dustman of the whole country; it labours with indefatigable industry to collect all the filth that might infest the air, and makes small balls of it, which it hides very deep in holes which it has dug in the earth; it breeds in sufficient numbers to keep the town and villages clean.

The LARVA of ELATER OBSCURUS, more commonly known by the name of the *Wire-worm*: it is of a very slender form, but so tough and horny that it can resist a considerable degree of pressure without injury. It is said to continue five years in the larva state, and during that time it lives in the earth, devouring the roots of various kinds of corn and vegetables. The damage it occasions in this way is so considerable, that whole fields of grain are destroyed; it is known to the farmers under the name of the *Fly*, which does so much injury to the young turnips.

The OIL BEETLE, (*Meloe Proscarabeus*) is entirely blue black or dark violet, it is found in the advanced state of spring in fields and pastures, creeping slowly; the body appearing so distended with eggs, as to cause the insect to move with difficulty. On being roughly touched

it suddenly exudes a yellowish moisture, (from whence it takes its name.) The female deposits her eggs in a heap beneath the surface of the ground, from these are hatched the larvæ, which find subsistence by attaching themselves to other insects, and absorbing their juices.

The *GYRINUS NATATOR*, or *Whirligig Beetle*. The following lively account of the manners of this species, is given by a popular writer : water, quiet, still water, affords a place of action to a very amusing little fellow, which about the middle of April, if the weather be tolerably mild, we see gamboling upon the surface of the sheltered pool, and every schoolboy who has angled for minnows in the brook, is well acquainted with this merry swimmer, in his shining black jacket; retiring in the autumn and reposing all the winter in the mud at the bottom of the pond, it awakens in the spring, rises to the surface and commences its summer sports; they associate in small parties of ten or a dozen near the bank, where some little projection forms a bay, or renders the water particularly tranquil, and here they will circle round each other without contention, each in his sphere and with no apparent object from morning until night, with great sprightliness and animation, and so lightly do they move on the fluid as to form only some faint and transient circles on its surface. Very fond of society we seldom see them alone, or if parted by accident they soon rejoin their busy companions. One pool commonly affords space for the amusement of several parties, yet they do not unite or contend, but perform their cheerful circlings in separate family associations; if we interfere with their merriment they seem greatly alarmed, disperse or dive to the bottom, when their fears shortly subside, as we soon again see our little merry friends gamboling as before. This plain, tiny, gliding, *Water Flea*, seems a very unlikely creature to arrest our young attentions; but the boy with his angle has not much to engage his notice, and the social active parties of this nimble swimmer, presenting themselves at these periods of vacancy, become insensibly familiar to his sight, and by many of us are not observed in after life without recalling former hours, scenes of perhaps less anxious days for trifles like these, by reason of some association are often remembered, when things of greater moment pass off and leave no trace upon the mind.

BUPRESTIS CHRYSIS and *BUPRESTIS STERNICORNIS*. The former of these *Beetles* is of a brown colour, the head and thorax are of a brilliant golden green, it is a native of the East Indies in some parts of which it appears to be rather common. The latter is of a bright green colour with golden reflections, likewise an inhabitant of the East Indies. A few species of *buprestidæ* inhabit this country, but their proper geographical position is within the tropics, where they may be seen flying about in great numbers in the open parts of the forests and on the margin of rivers, or reposing the trunks or leaves of trees, as if enjoying the heat of the meridian sun, which is reflected with great brilliancy from their polished surfaces.

CETONIA AURATA or *Rose Beetle*. Rosel informs us, that he kept the

species, known in this country as the *Rose Chafer*; alive for upwards of three years, by feeding it with fruit and moistened white bread. It is about the size of the common black garden *Beetle*, the colour is most brilliantly varnished and of a golden green. It is not very uncommon during the hottest parts of summer, frequenting various plants and flowers, its larva is commonly found in the hollows of old trees, or among the loose dry soil at their roots, and sometimes in the earth of ant hills.

LAMPYRIS NOCTILUCA, or *Glow-worm*, is seen during the summer months on dry banks about woods and pastures, exhibiting as soon as it is dusk vivid and phosphoric splendor, in the form of a round spot of considerable size. The animal itself, which is the female insect, measures about three quarters of an inch in length, and is of a dull earthy brown on the upper parts, and beneath more or less tinged with rose colour, with the two or three last joints on the body of a pale or whitish sulphur colour; it is from these parts that the phosphoric light proceeds. The male is smaller than the female, and is provided with wings and wing sheaths; but it is not determined whether it is luminous or not.

CICENDELA CAMPESTRIS or *Tiger Beetle*, is one of the most beautiful of our indigenous insects. It is of a fine green colour, glossed with coppery red, and having five yellowish spots on the margin of each elytron, and another towards the middle. The *Cicindelæ*, by their rapacity, have procured them the name of *Tiger Beetles*. They prey indiscriminately on other insects, and few of the smaller kinds are capable of eluding or resisting their attack.

THE COMMON COCKCHAFER (*Melolontha Vulgaris*); the larva of this insect, called by the farmers the *Grub*, which does so much injury to the crops, are three years coming to perfection; during this time they do immense injury, burrowing between the turf and the soil, and devouring the roots of grass and other plants. The mother *Cockchafer*, when about to lay her eggs, digs into the earth of a meadow or corn field to the depth of a span, and deposits them in a cluster at the bottom of the excavation. Rosel, in order to watch their proceedings, put some females into glasses half-filled with earth, covered with a tuft of grass, and a piece of thin muslin; in a fortnight he found some hundreds of eggs deposited, of an oval shape and a pale yellow colour. Placing the glass in a cellar, the eggs were hatched towards autumn, and the *Grubs* increased remarkably in size. In the following May they fed so voraciously, that they required a fresh turf every second day, and even this proving too scanty provender, he sowed in several garden pots a crop of peas, lentils and salad; and when the plants came up he put a pair of *Grubs* in each pot, and in this manner fed them through the second and third years. During this period, they cast their skins three or four times, going for this purpose deeper into the earth, and burrowing out a hole, where they might effect their change undisturbed, and they do the same in the winter, during which they become torpid and do not eat. When the *Grub* changes into a pupa, in the third autumn after it is hatched,

it digs a similar burrow about a yard deep, and when kept in a pot and prevented from going deep enough, it shows great uneasiness and often dies. The perfect *Beetle* comes forth from the pupa in January or February; but it is then as soft as it was whilst still a *Grub*, and does not acquire its hardness and colour for ten or twelve days, nor does it venture above ground before May, on the fourth year from the time of its hatching. At this time, the beetles may be observed issuing from their holes in the evening, and dashing themselves about in the air as if blind.

Another *Beetle Grub*, popularly called the *Meal Worm*, the larva of (*Tenebrio Molitor*) which lives in that state two years, does no little damage to flour, as well as to bread, cakes, biscuit and similar articles, Sparrman tells us, that he has witnessed the ground peas on shipboard, so infested with these *Grubs*, that they were seen in every spoonful of soup.

THE NUT WEEVIL (*Balaminus Nucum.*) This *Weevil*, like the rest of its congeners, is furnished with an instrument for depositing its eggs, considerably different from those of the *Ichneumon* and *Saw flies*. For this purpose the *Weevil* makes use of its long horny beak (*Rostrum*), to drill a hole in filberts and hazel nuts, while in their young and soft state about the beginning of August. The mother *Weevil* may then be seen eagerly running over the bushes, and it would appear that she always rejects the nuts, in which one of her neighbours may have previously laid an egg, at least we never find two *Grubs* in the same nut. The egg which is thus thrust in the young nut, is of a brown colour, and is hatched in about a fortnight; the *Grub* feeding on the interior of the shell as well as the soft pulp, till the one becomes too hard, and the other too dry to be nutritive. It is remarkable that during this period, he takes care not to injure the kernel, but permits it to ripen before he attacks it. Had he done this prematurely, he would have ultimately been starved, as he has not the power of perforating another nut, when the first is consumed. It is said also, that he is very careful to preserve the original hole made by the mother, by gnawing round its inner edges in order to facilitate his exit, which he effects when the nut falls to the ground in September or October. The hole found in the nut appears much too small to have admitted of its passage, but from being very soft, it no doubt stretches itself out for the purpose, using its short claws as instruments of motion. Rosel, in order to observe the transformation of these nut *Grubs*, put a number of them at the commencement of winter into glasses half-filled with earth, covered with green turf. All of them dug directly down into the earth, remained there all the winter, and did not change into pupæ till the following June, the perfect *Weevils* appeared from the 1st till about the 20th of August; but still kept under-ground for the first week after their change.

Some of the larvæ of *Beetles* excavate galleries in the soft inner bark of trees or between it and the young wood. In 1783 the trees destroyed





Hemiptera.

Fulgora Candelaria. (Lantern Fly.)



Lepidoptera.

Papilio Machaon. (Swallow Tailed Butterfly.)

by the *Printer Beetle* (*Tomicus Typographus* so called from its track, resembling letters,) amounted to above a million and a half, in the Hartz Forest. It appears there periodically, and confines its ravages to the fir.

THE CAPRICORN BEETLE (*Cerambyx Lamia Amputator*) is no less destructive to bark in its perfect state than the above are when grubs, as from its habits of eating round a tree it cuts the source of the returning sap and destroys it.

I shall now proceed to describe some of those insects belonging to the second division, namely: HEMIPTERA, the various instances of voracity that I have before described sink into insignificance when compared with the terrible devastation produced by the *Locust* (*Locusta migratoria*). The intelligent traveller, DR. SHAW, was an eye-witness of their devastations in Barbary in 1724, where they first appeared about the end of March; their numbers increasing so much in the beginning of April, as literally to darken the sun. By the middle of May they began to disappear, retiring into the Mettazah and other adjacent plains to deposit their eggs; these were no sooner hatched in June, he continues, than each of the broods collected itself into a square compact body of a furlong or more in size and marching afterwards directly forwards to the sea, they let nothing escape them. They kept their ranks like men of war, climbing over as they advanced every tree or wall that was in their way; nay, they entered into our very houses and bed-chambers like so many thieves. The inhabitants to stop their progress, formed trenches all over their fields and gardens which they filled with water; some placed large quantities of heath, stubble, and other combustible matters in rows, and set them on fire on the approach of the *Locusts*; but this was all to no purpose for the trenches were quickly filled up and the fires put out by the immense swarms that succeeded each other. Pallas gives a more detailed account of the daily proceedings of the larvæ of the *Italian Locust* (*Locusta Italica*). In serene weather, he tells us, the *Locusts* are in full motion in the morning immediately after the evaporation of the dew, and if no dew has fallen they appear as soon as the sun imparts his genial warmth; at first some are seen running about like messengers, among the reposing swarms which are lying partly compressed upon the ground at the side of small eminences, and partly attached to tall plants and shrubs; shortly after the whole body begins to move forward in one direction and with little deviation. They resemble a swarm of ants all taking the same course at small distances but without touching each other, they uniformly travel towards a certain region as fast as a fly can run, and without leaping unless pursued, in which case indeed they disperse, but soon collect again and follow their former route. In this manner they advance from morning to evening without halting, frequently at the rate of a hundred fathoms and upwards in the course of a day. Although they prefer marching along high roads, footpaths, or open tracts, yet when their progress is opposed by bushes, hedges and ditches,

they penetrate through them ; their way can only be impeded by the waters of brooks or canals, as they are apparently terrified at every kind of moisture ; often however they endeavour to gain the opposite bank with the aid of overhanging boughs, and if the stalks of plants or shrubs be laid across the water they pass in close columns over these temporary bridges on which they even seem to rest and enjoy the refreshing coolness. Towards sunset the whole swarm gradually collect in parties, and creep up the plants or encamp on slight eminences. On cold cloudy or rainy days they do not travel. As soon as they acquire wings they progressively disperse, but still fly about in large swarms. Even our own island has been alarmed by the appearance of *Locusts* a considerable number having visited us in 1743, but they happily perished without propagating. Other parts of Europe have not been so fortunate, in 1650 a cloud of *Locusts*, were seen to enter Russia in three different places, and they afterwards spread themselves over Poland and Lithuania in such astonishing multitudes that the air was darkened and the earth covered with their numbers ; in some places they were seen lying dead, heaped upon each other to the depth of four feet, in others they covered the surface of the ground like a black cloth ; the trees bent with their weight, and the damage the country sustained exceeded computation. They have frequently come also from Africa into Italy and Spain. In the year 591 an infinite army of *Locusts*, of a size unusually large, ravaged a considerable part of Italy ; and being at last cast into the sea (as seems for the most part to be their fate) a pestilence, it is alledged, arose from their stench, which carried off nearly a million of men and beasts. In the Venetian territory, likewise, in 1478 more than 30,000 persons are said to have perished in a famine, chiefly occasioned by the depredation of *Locusts*.

The MOLE CRICKET (*Gryllotalpa vulgaris*) is but too well known in gardens and cornfields in some parts of England, such as Wiltshire and Hampshire, though it is comparatively rare or unknown in others. It burrows in the ground, and forms extensive galleries similar to those of the mole though smaller, and these may always be recognized by a slightly elevated ridge of mould ; for the insect does not throw up the earth in hillocks like the mole, but gradually as it digs along in the manner of the field mouse ; in this way it commits great ravages in hot beds, and in gardens upon pease, young cabbages, and other vegetables, the roots of which it is said to devour. The nest which the female constructs for her eggs in the beginning of May, is well worthy of attention. The Rev. Mr. White, of Selborne, tells us that a gardener, at a house where he was on a visit, while mowing grass by the side of a canal, chanced to strike his scythe too deep and pared off a large piece of turf, laying open to view, an interesting scene of domestic economy : there was a pretty chamber dug in the clay, of the form and about the dimensions it would have had if moulded by an egg ; the walls being neatly smoothed and polished. In this little cell were deposited about a hundred eggs, of the size and form of caraway comfits, and of a dull tarnished

white colour ; the eggs were not very deep, but just under a little heap of fresh mould, and within the influence of the sun's heat.

The COCHENILLE INSECTS (*Coccidæ*), so called, from one of the species furnishing the well-known valuable dye stuff, protect their eggs in a very remarkable manner. The mother deposits her eggs under her body, which becomes glued to the spot, she then dies, and her body becomes a covering for the eggs ; in this state the insects appear on the bark of trees, like small warts in the form of a boat ; and, before their history was understood, they were with some plausibility supposed to be vegetable galls, whence they were termed *Gall Insects* by the French. Though the mother insect is seldom larger than a peppercorn, the number of eggs which she lays, amounts to several thousands, and in fact fills the greater portion of her body.

The COCCUS CACTI is the famous cochineal animal, and is a native of the warm parts of America. The female, which alone is valuable for its colour, is slothful and ill shaped ; the male is scarce, it is small, slender and active. At Oaxaca in Mexico, the *Cochineal* insects are gathered in large quantities, and the cultivation of them is the employment of the Indians. In trade there are four sorts of *Cochineal*, *Mastique*, *Campeschane*, *Tetraschale*, and *Sylvester*. The first is the best, and the last the worst ; the *Cochineal* is esteemed in medicine as a cordial, sudorific and febrifuge ; but it is chiefly used by dyers and painters.

The PRAYING MANTIS is a very curious insect, it is nearly three inches in length, of a slender shape, and in its general sitting posture is observed to hold up the two fore legs, as if in the act of devotion. The monkish legends tell us that St. Francis Xavier, walking one day in a garden, and seeing an insect of the *Mantis* genus moving along in its solemn way, holding up its two fore legs, as if in the act of devotion, desired it to sing the praises of God. The legend adds, that the saint immediately heard the insect carol a fine canticle with a loud emphasis. This insect is of a predacious disposition, living on smaller insects ; which it watches for with great anxiety ; it is also very pugnacious, and when kept with others of its own species in a state of captivity, they will attack each other with the utmost violence till one is destroyed, and the conqueror devours his antagonist.

The SPECTRES (*Phasmata*) resemble the smaller branches of trees with their spray, and so minutely detailed is this mimicry, that the very snags and knobs are accurately imitated.

I shall now proceed to LEPIDOPTERA :—The PAPILIO MACHAON or *Swallow Tailed Butterfly*, is the most beautiful of the English species, it is black and yellow, with hinder wings tailed ; it is very local, occurring near Bristol and Beverley, and in the Fens of Lincolnshire. The proceedings of the *Caterpillar*, before it changes into the pupa is very curious ; the insect first attaches the end of his thread to the spot selected for hanging up the chrysalis, such as the

bend of a branch of fennel or wild carrot, on which it has been feeding, and extends it outwards by the hooks on his claws, by which means he keeps it stretched till he fixes it on the other side, forming a loop about twice the diameter of his body. He repeats this process successively, till he has spun forty, sixty, or as many threads as he deems strong enough for his cincture, and then throwing it over his head towards the middle of his body, he proceeds to disencumber himself of his old skin. As the numerous threads composing the cincture are not glued together, but remain separate, it sometimes happens that they slip in whole or in part from the claws of the *Caterpillar*, and R  aumur had one which was foiled in all its efforts to repair such an accident. It did not indeed make any attempt to spin a fresh cincture, probably from its materials being exhausted or from want of strength, so that when it could not recover the fallen and entangled threads, it collected a few of them suspended, in which it cast its skin; but they being too weak to sustain it gave way, and it fell and perished; the perfect *Butterfly* appears the end of May and beginning of August.

ADIPPE or *High Brown Fritillary*, the wings are indented tawny with lilac spots, and 23 silvery spots underneath. The *Caterpillars* are brown with numerous red spines, and a black line close to a white one. They are produced from the egg in July, and feed until September, when they spin a fine web, under which they pass the winter, at the root of the *viola odorata*, or *viola tricolor*, on which they feed. In Spring and in June they change to brown *Chrysalides* with silver dots, and remain three weeks in the *Chrysalis* state. They generally frequent woods, and fly very swift, and I have myself been chasing them for two hours, before I could obtain one specimen.*

The VANESSA ATALANTA or *Red Admirable*. The *Caterpillar* of this *Butterfly*, before it changes into the pupa, suspends itself to some spot; the *Caterpillar* begins, in order to attach itself securely, to weave a mooring of silk, the structure of which is well worthy of notice; the threads of which this is composed are so fine that they are not easily distinguished. The silk threads are not drawn tight along, so as to be parallel with the surface, but are formed into a sort of projecting button; the *Caterpillar* for this purpose alternately raising and depressing its head over the spot, so as to draw out the threads in the same way as a tambouring needle is worked in making a dot upon muslin, the base is accordingly made the broadest part, and the centre the most projecting for a reason which will immediately appear. When it has finished this little button of silk, which is thickly interlaced and strong, it turns round to examine it with its hinder pair of pro-legs, and if it judges it to be sufficiently firm, it thrusts these among the meshes, taking secure hold with the numerous hooks with which these are fringed, and swings itself fearlessly into the air, hanging with its head downwards. All this seems easy enough of performance, but it is only

preliminary, for it has still to throw off its skin together with the hooks by which it is suspended, and this without losing its hold. The old skin is rent by the forcible bending round of the upper part of the body, which pushes through the angular projections of the *Chrysalis*, a tedious and probably a painful operation, in which it is often engaged the greater part of a day, and sometimes two according to its strength. When the first rent is made, however, the included *Chrysalis* soon wedges itself through the breach, the lower portion swelling out greatly more than the upper, so as to form an inverted but somewhat irregular cone. The included insect continuing its laborious exertions, by successively contracting and dilating the rings of its body, pushes off the now rent skin by degrees from the head towards the tail, as one would roll down a stocking from the leg. There are two circumstances worthy of notice in this process, the position of the insect in hanging with its head downwards, throws a greater portion of the fluids of the body towards the head, by means of their weight, which swell out the part that splits, and also pushes back the old skin, while the sloughing skin is prevented from resiliating by a series of pegs, which act like the toothed rack of a sluice gate. The old skin being by these means pushed towards the tail, is of course compressed into several folds, which in some degree prevent the extension of the rent, and serve to keep the *Chrysalis* from falling, for being now detached from the skin, it has no hold upon the meshes of the silk button, and is in fact at some distance from it. This then is the part of the process where the nicety of the mechanism is most worthy of admiration, for the hooks by which the insect is in the first instance suspended from the meshes of the silk, are sloughed off together with the skin, the grasp of whose folds becomes then the only support of the *Chrysalis*. But this *Chrysalis* now deprived of feet, and some distance from the suspensary cordage of silk, has still to reach this, fix itself there, and cast off the sloughed skin altogether. This operation causes, says Bonnet, a spectator to tremble for the consequences, for every movement seems to render its fall almost certain. It is, however, provided with means which answer the same purpose as hands to enable it to climb, it can elongate and contract at pleasure the rings of its body; it accordingly with two contiguous rings lays hold, as with a pair of pincers, of the portion of the sloughed skin nearest the head, and elongating the rings beyond this seizes upon a more distant portion, while it lets go the first; repeating the process several times it arrives at the silk button. The *Caterpillar* is solitary, spinous, and greenish, with a yellowish lateral line; at the end of July changes into the pupa; in fourteen days after becoming a *Chrysalis*, the *Butterfly* appears.

The VANESSA Io (*Peacock Butterfly*) appears in spring, and the middle of July, till late in autumn; wings above purplish or reddish brown, with a large eye-like spot near the tip of the first, and towards the margin of the second pair, underneath brown, marbled, banded, and

spotted with black. *Caterpillar* gregarious, black spotted with white; the feet rust coloured; feeds on the nettle. *Chrysalis* green, gold spotted. Common in the south of England, and found also in Yorkshire and Scotland.

The TORTOISESHELL (*Vanessa Urticæ*) appears in spring; the end of June, and beginning of September, wings above deep orange, base black, hinder margin black, with a series of blue crescents, *Caterpillar* dusky, head black, when young it is gregarious. Common throughout the kingdom.

The PROCESSION MOTH (*Cnèthocampa Processionea*). The *Caterpillar* of this *Moth* feeds on the oak a brood dividing when nearly hatched into one or more parties of several hundred individuals, which afterwards unite in constructing a common nest, nearly two feet long and from four to six inches in diameter. As it is not divided like that of the brown tails into chambers, but consists of one large hall, it is not necessary that there should be more openings, than one; and accordingly when an individual goes out and carpets a path, the whole colony instinctively follow in the same track, though from the immense population, they are often compelled to march in parallel files from two to six deep. The procession is always headed by a single *Caterpillar*, sometimes the leader is immediately followed by one or two in single file, and sometimes by two abreast.

The GOAT MOTH (*Cossus Ligniperda*.) The *Caterpillar* of this *Moth*, which abound in Kent and many other parts of the Island, feeds on the wood of willows, oaks, poplars, and other trees, in which it eats extensive galleries; but it is not contented with the protection afforded by these galleries during the colder months of winter, before the arrival of which, it scoops out a hollow in the tree, if it does not find one ready prepared, sufficiently large to contain its body in a bent or somewhat coiled up position. Rennie thus speaks of it: "On sawing off a portion of an old poplar in the winter of 1827, we found such a cell with a *Caterpillar* coiled up in it. It had not, however, been contented with the bare walls of the retreat, which it had hewn out of the tree, for it had lined it with a fabric as thick as coarse broad cloth and equally warm, composed of the raspings of the wood scraped out of the cell, united with the strong silk which every species of *Caterpillar* can spin. In this snug retreat our *Caterpillar*, if it had not been disturbed, would have spent the winter without eating; but upon being removed into a warm room and placed under a glass, along with some pieces of wood which it might eat if so inclined, it was roused for a time from its dormant state, and began to move about. It was not long, however, in constructing a new cell for itself, no less ingenious than that of the former. It either would not gnaw into the fir plank, where it was now placed with a glass above it, or it did not choose to do so, for it left it untouched and made it the basis of the edifice it began to construct; it formed, in fact, a covering for itself, precisely like the one from which we had dislodged it, composed of raspings of wood

detached for the purpose from what had been given it as food ; the largest piece of wood had been employed as a substantial covering, and protection for the whole. It remained in this retreat motionless and without food, till revived by the warmth of the ensuing spring ; when it gnawed its way out, and began to eat voraciously to make up for its long fast. These *Caterpillars* are three years in arriving at their final change into the winged state ; but as the one just mentioned was nearly full grown, it began in the month of May to prepare a cell in which it might undergo its metamorphosis. Whether it had actually improved its skill in architecture by its previous experience, we will not undertake to say, but its second cell was greatly superior to the first. In the first, there was only one large piece of wood employed ; in the second, two pieces were placed in such a manner as to support each other, and beneath the angle thus formed an oblong structure, was made, composed as before of wood raspings and silk, but much stronger in texture than the winter cell, In a few weeks (four if we recollect aright), the *Moth* came forth."

Second Lecture.

The CLOTHES MOTH (*Tinea Destructor*). The mother insect takes care to deposit her eggs on or near such substances, as she instinctively foreknows will be best adapted for the food of the young, taking care to distribute them so that there may be a plentiful supply, and enough room for each, for example some of the *Caterpillars* feed upon the shreds of cloth used in training wall fruit trees ; but there is never found more than two on the same shred. This scattering of the eggs in many places, renders the effects of the *Caterpillars* more injurious, from their attacking many parts of a garment, or a piece of stuff at the same time. When one of the *Caterpillars* of this family issues from the egg, its first care is to provide itself with a domicile, which indeed seems no less indispensable than food, for, like all *Caterpillars* that feed under cover, it will not eat while it remains unprotected. Its mode of building is very similar to that which is employed by other *Caterpillars*, that make use of extraneous materials. The foundation or frame work is made of silk secreted by itself, and into this it interweaves portions of the materials upon which it feeds. We have repeatedly witnessed (says Rennie), the proceedings of these insects from the very foundation of their structure, and at the moment of writing this, we turned out one from the carcase of an *Old Lady Moth* (*Mormo Maura*) in our cabinet, and placed it on a desk covered with green cloth, where it found materials to construct another dwelling. It wandered about for half a day before it began its operations ; but it did not, as asserted by Bonnet, Kirby, and Spence, in moving from place to place, seem to be as much incommoded by the long hairs which surrounded it, as we are by walking amongst high grass ; nor accordingly, marching scythe in hand,

did it with its teeth cut out a smooth road ; on the contrary, it did not cut a single hair, till it selected one for the foundation of its intended structure. This it cut very near the cloth, in order we suppose to have it as long as possible, and placed it on a line with its body. It then immediately cut another and, placing it parallel to the first, bound both together with a few threads of its own silk ; the same process was repeated with other hairs, till the little creature had made a fabric of some thickness ; and this it went on to extend till it was large enough to cover its body, which (as is usual with *Caterpillars*) it employed as a model and measure for regulating its operations. We remarked, that it made choice of longer hairs for the outside than for the parts of the interior, which it thought necessary to strengthen by fresh additions ; but the chamber was ultimately finished by a fine and closely woven tapestry of silk. We could see the progress of its work by looking into the opening at either of the ends, for at this stage of the structure the walls are quite opaque and the insect concealed. It may be thus observed to turn round, by doubling itself and bringing its head where the tail had just been, of course the interior is left wide enough for this purpose, and the centre indeed where it turns is always wider than the extremities. The effluvium of camphor or turpentine will kill them when in the winged state, which is the time when the mischief is first done ; and if camphor is laid in the drawers or other places, where woollen or furs are placed, it will preserve them from being destroyed ; but this will have no effect if they have already laid their eggs, and seldom upon the *Caterpillars*, for they wrap themselves up too closely to be easily reached by any agent except heat. This when it can be conveniently applied, will be certain either to dislodge or kill them ; when the effluvium of turpentine however reaches the *Caterpillar*, Bonnet says, it falls into convulsions, becomes covered with livid blotches and dies.

The *GONEPTERYX RHAMNI* ; or *Brimstone Butterfly*, is a very pretty insect ; it appears the middle of February, beginning of June. and in autumn. Wings two inches and a half angular, primrose yellow in the male, greenish white in the female, each with a darker spot ; *Caterpillar* pale green with a whitish stripe on the sides ; feeds on the buckthorn and berry bearing alder.

The *CATERPILLARS* of a family of small *Moths* (*Tineidæ*), which feed on the leaves of various trees, such as the hawthorn, the elm, the oak, and most fruit trees, particularly the pear, form habitations which are exceedingly ingenious and elegant. They are so very minute that they require close inspection to discover them, and to the cursory observer unacquainted with their habits, they will appear more like the withered leaf scales of the tree, thrown off when the buds expand, than artificial structures made by insects. It is only indeed by seeing them move about upon the leaves, that we discover they are inhabited by a living tenant, who carries them as the snail does his shell. These tents are

from a quarter of an inch to an inch in length, and usually about the breadth of an oat straw. That they are the colour of a withered leaf is not surprising, for they are actually composed of a piece of leaf, not however cut out from the whole thickness ; but artfully separated from the upper layer, as a person might separate one of the leaves of paper from a sheet of pasteboard.

SPHINX LIGUSTRI (*Privet Hawk Moth.*) This is one of the largest species of Lepidopterous insects, it appears at the end of June and beginning of July. It flies for the most part early in the morning or late in the evening. It changes into a pupa sometimes under leaves, but mostly in the earth. It flies with great rapidity and makes a noise with its wings. The *Caterpillar* feeds on the privet, lilac, ash, alder, and willow. It goes into the *Chrysalis* in August, and the *Moth* appears the following June.

The *BUFF TIP* (*Pygæra Bucephala.*) In 1826 Colonies of the *Caterpillar* of this *Moth* were in some parts of the country very abundant. They were remarked particularly at Harrow on the Hill and at Compton Basset, in Wiltshire. From their feeding in company, they strip a tree, branch after branch ; scarcely leaving the fragment of a leaf, till a great portion of it is completely bare. Some of the magnificent beeches in Compton Park, from this cause appeared with the one half of their branches leafless and naked, while the other half was untouched. Besides the beech these *Caterpillars* feed on the oak, the lime, the hazel, the elm, and the willow. When newly hatched they may readily be discovered, from their singular manner of marshalling themselves, like a file of soldiers, on a single leaf, only eating it half through ; and in their more advanced stage, their gaudy stripes of yellow and black, make them very conspicuous on the branches which they have nearly stripped bare. The *Cuckoo* feeds as greedily upon them, as they do on leaves, and may be seen early in the morning perched in the midst of their colonies, and devouring them by dozens.

The *EMPEROR MOTH* is no less worthy of our attention, with respect to the ingenuity of its architecture than the beauty of its colours, and has consequently attracted the attention of every Entomologist. The *Caterpillar* feeds on fruit trees and on the willow, and spins a cocoon in the form of a Florence flask, of strong silk, so thickly woven that it appears almost like damask or leather. It differs from most other cocoons in not being closed at the upper or smaller end, which terminates in a narrow circular aperture, formed by the convergence of little bundles of silk gummed together, and almost as elastic as whalebone. In consequence of all these terminating in needle-shaped points, the entrance of depredators is guarded against, upon the principle which prevents the escape of a mouse from a wire-trap. The insect, however, not contented with this protection, constructs another in form of a canopy or dome within the external aperture, so as effectually to shield the *Chrysalis* from danger. The cocoon of the *Emperor Moth*, though thus in

some measure impenetrable from without, is readily opened from within ; and when the *Moth* issues from its pupa case, it easily makes its way out, without either the acid or eye files ascribed to the *Silkworm*. The elastic silk gives way upon being pushed from within and, when the insect is fairly out, it shuts again of its own accord like a door with spring hinges ; a circumstance which at first puzzled Rœsel not a little, when he saw a fine large *Moth* in his box, and the cocoon apparently in the same state as when he had put it there.

The SILK WORM is too well known to require description ; but some particulars relative to the silk, and the early history of this renowned insect may not be considered uninteresting. In ancient times the manufacture of silk was confined to the East Indies and China, where the insects that produce it are indigenous. It was thence brought to Europe in small quantities, and in early times sold at so extravagant a price, that it was deemed too expensive even for royalty. The Emperor Aurelian assigned the expence as a reason for refusing his Empress a robe of silk ; and our own James I., before his accession to the crown of England, had to borrow of the Earl of Mar a pair of silk stockings to appear in before the English Ambassador ; a circumstance which probably led him to promote the cultivation of silk in England. The Roman authors were altogether ignorant of its origin, some supposing it to be grown on trees, as hair grows on animals ; others that it was produced by a shell-fish, similar to the muscle which is known to throw out threads, for the purpose of attaching itself to rocks ; others that it was the entrails of a sort of spider, which was fed for four years with paste, and then with the leaves of the green willow, till it burst with fat ; and others that it was the produce of a worm, which built nests of clay and collected wax. The insect was at length spread into Persia, and its eggs were afterwards, at the instance of the Emperor Justinian, concealed in hollow canes by two monks, and conveyed to the Isle of Cos. This emperor, in the sixth century, caused them to be introduced into Constantinople, and made an object of public utility. They were thence successively cultivated in Greece, in Arabia, in Spain, in Italy, in France, and in all places where any hope could be indulged of their succeeding.

In America, the culture of the *Silk-worm* was introduced into Virginia in the time of James I. who himself composed a book of instructions on the subject, and caused mulberry-trees and *Silk-worm's* eggs to be sent to the colony. In Georgia also, lands were granted, on condition of planting one hundred white mulberry-trees on every ten acres of cleared land. The growth of the *Silk-worm* has also been tried, but with no great success in this country. Evelyn computed that one mulberry-tree would feed as many *Silk-worms* annually, as would produce seven pounds of silk. According to that estimate, says Barham, the 2000 trees already planted in Chelsea Park, (which take up one third of it) ; will make 14,000lbs, weight of silk ; to be commonly worth but 20s. a pound, those trees must make £14,000 per annum. During the last



Neuroptera.

Libellula grandis



Hymenoptera.

Apis. (The Bee.)

century some French refugees in the South of Ireland, made considerable plantations of the mulberry, and had begun the cultivation of silk with every appearance of success ; but since their removal, the trees have been cut down. In the vicinity of London also a considerable plantation of mulberry-trees were purchased by the British, Irish, and Colonial Silk Company in 1825 ; but I have not learned whether this company have any active measures now in operation.

The six spot BURNET HAWK MOTH (*Anthracera Filipendulæ*) appears the end of June or beginning of July. Wings one inch one half to seven twelfths, first pair azure blue with six blood red spots, second pair deep red with an indistinct dark blue margin, abdomen spotless black ; *Caterpillar* primrose yellow, with three rows of black spots on the back, and a row of smaller ones on each side, head black, feeds on plaintain, clover, dandelion, mouse-ear, hawkseed, quake grass, &c. *Chrysalis* yellow ; common in the North of England, Devonshire, South Wales, and near London.

The HONEYCOMB MOTH (*Galleria Cereana*) does very considerable damage to the hives of *Bees*. The *Moth* appears about the end of June or beginning of July, and when in danger it runs rather than flies, gliding with such celerity, that they can easily elude the vigilance of the *Bees* ; which indeed, if we may trust *Swammerdam*, never attack it, nor prevent its entrance into the hive, unless it chances to brush against them in its passage. But Réaumur actually saw the *Bees* pursue one though without success. It becomes easy for a *Moth*, at all events, to lay eggs among the combs or, as Keys says, at the entrance of the hive. This writer adds she spins a close and strong web to defend the young, which is impossible, as no insect subsequent to its larva state can spin. The *Caterpillar* wherever it passes, says *Swammerdam*, gnaws round holes through the waxen cells ; one *Caterpillar* sometimes breaking open and destroying fifty or sixty cells. Wherever it penetrates, it always fabricates a hollow tubulated web, in which, as a rabbit in its burrow, it can very swiftly pass from one part to another, and speedily run back again. It fills the whole comb with such webs, and turns itself in them every way into various turnings and windings, so that the *Bees* are not only perplexed and disturbed in their work, but they frequently entangle themselves by the claws and hairs of their legs in those webs and the whole hive is destroyed.

The next division of the seven orders, is NEUROPTERA. The ANT LION (*Myrmeleon Formicarius*.) The observations of the continental naturalists have made known to us a pitfall constructed by an insect, the details of whose operations are exceedingly curious ; we refer to the *Grub* of the *Ant Lion*, which, though marked by Dr. Turton and Mr. Stewart as British, has not (at least of late years) been found in this country. As it is not however uncommon in France and Switzerland, it is probable it may yet be discovered in some spot hitherto unexplored, and if so it will well reward the search of the curious. The *Ant Lion*

Grub being of a grey colour, and having its body composed of rings, is not unlike a *Woodlouse* (*Oniscus*), though it is larger, more triangular, has only six legs, and most formidable jaws in form of a reaping hook, or a pair of calliper compasses. The jaws, are however, not for masticating, but are perforated and tubular, for the purpose of sucking the juices of *Ants*, upon which it feeds. Vallisnieri was therefore mistaken, as Réaumur well remarks, when he supposed that he had discovered its mouth. Its habits require that it should walk backwards, and this is the only species of locomotion which it can perform. Even this sort of motion it executes very slowly, and were it not for the ingenuity of its stratagems, it would fare but sparingly; since its chief food consists of *Ants*, whose activity and swiftness of foot would otherwise render it impossible for it to make a single capture. Nature however in this, as in nearly every other case, has given a compensating power to the individual animal to balance its privation. The *Ant Lion* is slow, but it is extremely sagacious it cannot follow its prey; but it can entrap it. The snare which the *Grub* of the *Ant Lion* employs, consists of a funnel shaped excavation formed in loose sand, at the bottom of which it lies in wait for the *Ants*, that chance to stumble over the margin, and cannot from the looseness of the walls gain a sufficient footing to effect their escape. When the pitfall is intended to be small, it only thrusts its body backwards. It then examines, the nature of the soil, whether it be sufficiently dry and fine for its purpose, and if so, it begins by tracing out a circle where the mouth of its funnel trap is intended to be. Having thus marked the limits of its pit, it proceeds to scoop out the interior. Getting within the circle, and using one of its legs as a shovel it places therewith a load of sand on the flat part of its head, and it throws the whole with a jerk, some inches beyond the circle. It is worthy of remark, that it only uses one leg in this operation, the one namely, which is nearest the centre of the circle. Were it to employ the others in digging away the sand, it would encroach upon the regularity of its plan. Working with great industry and adroitness (in the manner we have just described), it quickly makes the round of its circle, and as it works backwards, it soon arrives at the point where it commenced. Instead, however, of proceeding from this point in the same direction as before, it wheels about and works a round in the contrary direction, and in this way it avoids throwing all the fatigue of the labour on one leg; alternating them every round of the circle. The pitfall when finished, is usually about three inches in diameter at the top, about two inches deep, and gradually contracting into a point, in the manner of a cone or funnel; in the bottom of this pit, the *Ant Lion* stations itself to watch for its prey. Should an *Ant* or any other insect wander within the verge of the funnel, it can scarcely fail to dislodge and roll down some particles of sand, which will give notice to the *Ant Lion* below to be on the alert. In order to secure the prey, Réaumur, Bonnet, and others, have observed the ingenious insect throw up

showers of sand, by jerking it from its head in quick succession, till the luckless *Ant* is precipitated within reach of the jaws of its concealed enemy. It feeds only on the blood or juice of insects, and as soon as it has extracted these, it tosses the dry carcase out of its den. Its next care is to mount the sides of the pitfall, and repair any damage it may have suffered, and when this is accomplished, it again buries itself among the sand at the bottom, leaving nothing but its jaws above the surface, ready to seize the next victim. When it is about to change into a pupa, it proceeds in nearly the same manner as the *Caterpillar* of the *Water Ebony Moth* (*Cucullia Scrophulariæ*). It first builds a case of sand, the particles of which are secured by threads of silk, and then tapestries, the whole with a silken web. Within this it undergoes its transformation into a pupa, and in due time it emerges in the form of a four winged *Fly* closely resembling the *Dragon Flies* (*Libellulæ*); vulgarly and erroneously called horse-stingers, as they are not provided with a sting.

The *Grubs* of several of the numerous species of *May Fly*, EPHEMERA, excavate burrows for themselves in soft earth on the banks of rivers and canals, under the level of the water; an operation well described by Réaumur. The excavations are always proportioned to the size of the inhabitant, and consequently, when it is young and small, the hole is proportionally small; though, with respect to extent, it is always at least double the length of its body. The hole being under the level of the river is always filled with water, so that the *Grub* swims in its native element; and, while it is secure from being preyed upon by fishes, it has its own food within easy reach. It feeds, in fact, upon the slime or moistened clay with which its hole is lined. It is usually about the middle of August that the *Ephemera* of the Seine and Marne (two rivers in France), are expected by the fishermen; and when their season is come, they talk of the *Manna* beginning to appear, calling the insects by this term on account of the quantity of food for the fish, which falls as the *manna* is recorded to have done in the desert. On the 19th of August, Réaumur, having received notice that the *Flies* had begun to appear, and that millions of them were coming out of the water, got into his boat about three hours before sunset, but after staying in the boat till eight o'clock without seeing any, he resolved, as a storm was foreboded, to return. He had previously detached from the banks of the river several masses of earth filled with *pupæ*, which he put into a large tub full of water. His servants, who were carrying the tub home, had scarcely set it upon one of the steps of the stairs leading from the garden to the Marne, when he heard them exclaim, "What a prodigious number of *Ephemera* are here!" He immediately seized one of the torches and ran to the tub, where he found every piece of earth above the surface of the water swarming with the *Flies*; some just beginning to quit their old skins, others preparing to fly, and others already on the wing, while every where under water they were seen in a greater or less degree of forwardness. The threatened storm of rain and lightning

at length coming on, he was compelled to leave this interesting scene ; but to prevent the escape of the insects he had the tub covered with a cloth. The violence of the rain ceased in about half an hour, when he returned to the garden, and as soon as the cloth was removed from the tub, he perceived that the number of *Flies* was prodigiously augmented, and continued to increase for some time as he stood watching them. Many flew away, and many more were drowned ; but the number which had already undergone their transformation from the earth in the tub would have been sufficient to fill it, exclusively of crowds of others which the light had attracted from a distance. He again spread the cloth over the tub, and the light was held above it, immediately the cloth was almost concealed by the vast multitudes which alighted upon it. What he had observed, however, at the tub, was nothing to the scene now exhibited on the banks of the river, to which he was again attracted by the exclamations of his gardener. The countless numbers, he says, of *Ephemerae* which swarmed over the water can neither be conceived nor expressed. When snow falls thickest, and in the largest flakes, the air is never so completely full of them as that which we witnessed filled with *Ephemerae*. I had scarcely remained a few minutes in one place when the step on which I stood was covered in every part with their bodies, from two to four inches in depth. Near the lowest step, a surface of water of five or six feet dimensions every way, was entirely covered with a thick layer of them ; and those which the stream swept away were more than replaced by the multitudes that were continually falling, and I was repeatedly compelled to abandon my station from not being able to bear the shower of insects which, not falling perpendicularly like rain, struck me incessantly, and in a manner extremely uncomfortable, pelting against every part of my face, and filling my eyes, nose, and mouth almost to suffocation. On this occasion it was no pleasant part to hold the light, for our torch-bearer had his clothes covered with insects in a few moments, which rushed in from all quarters to overwhelm him. The light of the torch gave origin to a spectacle which enchanted every one who beheld it, and altogether different from a meteorological shower—even the most stupid and unobserving of my domestics were never satisfied with gazing at it. No armillary sphere was ever formed of so many circular zones in every possible direction, having the light for their common centre. Their number seemed to be infinite, crossing each other in all directions and in every imaginable degree and inclination, all of which were more or less oblique. Each of these zones was composed of an unbroken string of *Ephemerae*, which followed each other close in the same line, as if they had been tied together head and tail, resembling a piece of silver ribbon deeply indented on its edges, and consisting of equal triangles placed end to end ; so that the angles of those that followed were supported by the base of those which preceded, the whole moving round with incredible velocity. This spectacle was caused by the wings of the *insects*, which

alone could be distinguished. Each of these *Flies*, after having described one or two orbits, fell to the earth or into the water, though not in consequence of being burned. He says, it is astonishing that the *Ephemera*, which appearing after sunset and dying before sunrise, are destined never to behold the dawn of day, should have so strong an inclination for any luminous object. Some of our British *Ephemera* begin their dances with the dawn instead of waiting till sunset, rising and falling continually over the meadows in May; sometimes beating the air rapidly with their wings, and sometimes skimming about like hawks.

There is a very interesting class of *Grubs* which live under the water, where they construct for themselves moveable tents of various materials as their habits direct them, or as the substances they require can be conveniently procured. Among the materials used by these singular *Grubs*, well known to fishermen by the name of *Caddis Worms*, and to naturalists as the *larvæ* of four-winged *Flies*, we may mention sandstones, shells, wood, and leaves, which are skilfully joined, and strongly cemented. One of these *Grubs* forms a pretty case of leaves glued together longitudinally, but leaving an aperture sufficiently large for the inhabitant to put out its head and shoulders when it wishes to look about for food. Another employs pieces of reed cut into convenient lengths, carefully joining and cementing each piece to its fellow as the work proceeds, and he frequently finishes the whole by adding a broad piece longer than the rest to shade his doorway overhead, so that he may not be seen from above. A more laborious structure is reared by the *Grub* of a beautiful *Caddis Fly* (*Phryganea*), which weaves together a group of the leaves of aquatic plants into a roundish ball, and in the interior of this forms a cell for its abode. Another of these aquatic architects makes choice of the tiny shells of young fresh water muscles and snails (*Planorbis*), to form a moveable grotto; and as these little shells are for the most part inhabited, he keeps the poor animals close prisoners, and drags them without mercy along with him. These grotto buildings are by no means uncommon in ponds and in chalk districts, such as the country about Woolwich and Gravesend. One of the most surprising instances of their skill occurs in the structures, of which small stones are the principal material. The problem is to make a tube about the width of the hollow of a wheat straw or a crow quill, and equally smooth and uniform. Now, the material being small stones full of angles and irregularities, the difficulty of performing this problem will appear to be considerable, if not insurmountable; yet the little insects, by patiently examining their stones, and turning them round on every side, never fail to accomplish their plan. This, however, is only part of the problem which is complicated with another condition, namely, that the under surface shall be flat and smooth, without any projecting angles, which might impede its progress when dragged along the bottom of the rivulet where it resides. The selection

of the stones, indeed, may be accounted for from this species living in streams where, but for the weight of its house, it would to a certainty be swept away. For this purpose it is probable that the *Grub* makes choice of larger stones than it might otherwise want, and therefore also it is that we frequently find a case composed of very small stones and sand, to which, when nearly finished, a large stone is added by way of ballast. In other instances, when the material is found to possess too great specific gravity, a bit of light wood or a hollow straw is added to buoy up the case. It is worthy of remark, that the cement used in all these cases is superior to *pozzolana* (a cement prepared of volcanic earth or lava), in standing water, which is indissoluble. The *Grubs* themselves are also admirably adapted for their mode of life, the portion of their bodies, which is always enclosed in a case, being soft like a *Meal Worm* or *Caterpillar*, while the head and shoulders, which are for the most part projected beyond the door-way in search of food, are firm, hard, and, consequently, less liable to injury than the protected portion, should it chance to be exposed. We have repeatedly, says Rennie, tried experiments with the inhabitants of those aquatic tents to ascertain their mode of building. We have deprived them of their little houses, and furnished them with materials for constructing new ones, watching their proceedings from the laying the first stone or shell of the structure. They work at the commencement in a very clumsy manner, attaching a great number of chips to whatever materials may be within their reach, with loose threads of silk, and many of these they never use at all in their perfect building. They act, indeed, much like an unskilful workman, trying his hand before committing himself upon an intended work of difficult execution. The main intention is, however, to have abundance of materials within their reach, for after their dwelling is fairly begun they shut themselves up in it, and do not again protrude more than half of their body to procure materials; and even when they have dragged a stone, a shell, or a chip of reed within building reach, they have often to reject it as unfit for use.

Before we began to study the habits of insects, says Rennie, we found upon a lilac twig in the neighbourhood of London a singular production, which we took for a very delicate *Fungus*, and supposing it not to be common we carefully preserved the specimens; but we have since learned, with no little surprise, that these are the eggs of the lace-winged *Fly*, (*Chrysopa Reticulata*). Réaumur says, that several naturalists have described them as *Fungi*, which is not to be wondered at, for they consist of a small oval greenish white head, similar to the apple mould, with a white transparent stem, more than an inch high, not thicker than a human hair, but much more stiff and rigid. About a dozen of these eggs are deposited in a single and sometimes in a double line upon the leaves and branches of elder, and other trees and plants abounding with *aphides*, upon which the *Grubs* feed when hatched. The footstalks of these eggs are formed by the mother *Fly* attaching a

drop of *gluten* to the branch, and drawing it out (as a spider does his line) to the requisite length before the egg is deposited upon the summit. As she uses her body for a measure, the footstalks are by consequence all nearly of equal length. It is evidently the design of these footstalks to place the eggs out of the reach of the *Grubs* of *Lady Birds* (*Coccinellæ*), and *Aphidivorous Flies* (*Syrphi*), which frequent the same situation and might devour them. The footstalks are so smooth and slender that these *Grubs* could not climb them, as we have proved by experiment.

A singular structure for respiration occurs in the aquatic larvæ of the *Dragon Flies*, *LIBELLULIDÆ*, which differ so remarkably from the perfect insect in the beauty of colour and elegance of form, that has procured for them the gallant appellation of *Demoiselles* (*damsels*) in France. This title agrees as badly with their habits as the popular English name of *Horse-stingers*, since they have no apparatus for stinging; and so far, says Réaumur, from seeking an innocent nutriment in the pulp of fruit or the nectar of flowers, they are more like amazons than damsels, hovering in the air only to pounce on other insects, which they crush with their powerful mandibles. Should they quit the margin of a pond or the banks of a rivulet, where they may be seen hawking about in multitudes, it is only to pursue and seize the *Moth* or the *Butterfly* that has fled for shelter to the bushes. Though these *Larvæ* are furnished with six feet, they not only move very little, but do not use them for walking so much as for capturing their prey. Their motion is effected by a very peculiar method. When one of these *Larvæ* is procured from the bottom of a pond or the pool of a brook, let it be put into a large saucer with water and some of the dead leaves or sticks it previously employed as a covering; these will soon be seen floating towards the tail, and afterwards repelled, as a floating feather will be by a stick of sealing-wax or a bit of amber when electrically excited. When the insect has been kept out of the water for a short time, the desire or necessity of respiration is increased, and when again put into the water, the pumping is repeated with unusual force and frequency. If it be held in the hand head downwards and some drops of water be let fall on the tail, it instantly sucks it in, and the dimensions of its body become visibly augmented; but it collapses again when the water is expelled, which is effected by the same apparatus. The *Larva* of the *Libellula* has placed on its head a horny consistence in plates resembling a mask, that if *Entomologists* ever went to masquerades, they could not more effectually relieve the insipidity of such amusements, and attract the attention of the *demoiselles*, than by appearing at the supper table with a mask of the same construction as the *Libellula*'s, and serving themselves by its assistance. It would be difficult to be sure by mechanism to supply the place of the muscles with which this insect is provided, but Merlin, or his successor, has surmounted greater obstacles. When the *pupa* is about to change to the perfect insect, it may be seen removing out of

the water to a dry place, such as a grassy bank or the stems of aquatic plants, into which it pushes its sharp claws and remains for a short time immoveable. By the swelling of the upper part of the body the envelope is soon distended, and bursts asunder on the back of the head and shoulders, and through this opening, first the head and then the legs of the perfect *Fly* make their exit, while the empty slough of the legs continues fixed in its place. After this first part of the process is accomplished, it hangs down its head and rests for a space, as if exhausted by previous exertion, or rather to allow the newly excluded parts to dry and become more firm. It next erects itself, and laying hold of the upper part of the slough with its feet, pulls the parts still enveloped further out, then creeping forward by degrees, it disengages the entire body, and again rests for a time immoveable. The wings now begin to expand themselves, and their plaits and folds become gradually smooth. The body, also, becomes insensibly larger and longer, and the limbs acquire their just size and proportions. While the wings are undergoing the operation of drying and expanding, the insect takes care to keep them from coming into contact with the body, by bending itself into the form of a crescent; for if they were obstructed whilst wet, they could not afterwards be set to rights. All these changes are perfected, according to Swammerdam, by the force of the circulating fluids and the air impelled by respiration, a fact of which there cannot be any doubt. It is very seldom, however, that they can be surprised at the precise moment of their transformation, as it is for the most part very speedily accomplished, for the whole of the preceding evolutions are usually completed in ten or fifteen minutes. It happened by mere chance, says Swammerdam, that I observed for the first time one of these *vermicles* adhering to a stone-wall in the river Loire (France), and it was so softened by the water dashing up against it, that it could only half perfect its change, so that I took it partly free and partly fixed in the skin. I once afterwards saw the change in the large kind of *Dragon Fly* (*Eshna*), which had crept to land out of a small lake, and cast its skin sitting in the grass.

HYMENOPTERA is the fifth order of insects. A very curious and interesting genera *Cynips*, whose nests are found in abundance during the summer on the leaves of the rose-tree, the oak, the poplar, the willow, and many other trees, in the globular form of a body about the size of a currant, and usually of a green-colour tinged with red, like a ripe Alban or Baltimore apple. When this pseudo apple in miniature is cut into, it is found to be fresh, firm, juicy, and hollow in the centre, where there is either an egg or a *Grub* safely lodged and protected from all ordinary accidents. Within this hollow ball the egg is hatched, and the *Grub* feeds securely on its substance, till it prepares for its winter sleep before changing into a *Gall Fly* (*Cynips*) in the ensuing summer. There is a mystery as to the manner in which this *Gall Fly* contrives to pro-

duce the hollow miniature apples, each inclosing one of her eggs; and the doubts attendant upon the subject cannot, so far as our present knowledge extends, be solved except by plausible conjectures. Our earlier naturalists were of opinion, that it was the *Grub* which produced the galls, by eating, when newly hatched, through the cuticle of the leaf, and so remaining till the juices flowing from the wound enveloped it, and acquired consistence by exposure to the air. This opinion, however plausible as it appeared to be, was at once disproved by finding unhatched eggs on opening the galls. There can be no doubt, indeed, that the mother *Gall Fly* makes a hole in the plant for the purpose of depositing her eggs. She is furnished with an admirable *ovipositor* for that express purpose, and Swammerdam actually saw a *Gall Fly* thus depositing her eggs.

In some of these insects the *ovipositor* is conspicuously long, even when the insect is at rest, but in others not above a line or two of it is visible till the belly of the insect is pressed. When this is done to the *Fly* that produces the currant gall of the oak, the *ovipositor* may be seen issuing from a sheath in the form of a small curved needle, of a chestnut brown colour, and of a horny substance, and three times as long as it first appeared. What is most remarkable in this *ovipositor* is, that it is much longer than the whole body of the insect in whose belly it is lodged in a sheath, and from its horny nature it cannot be either shortened or lengthened. It is on this account, that it is bent into the same curve as the body of the insect. The mechanism by which this is effected is similar to that of the tongue of a *Woodpecker* (*Picus*), which, though rather short, can be darted out far beyond the beak, by means of the hyoid-bone (a forked bone at the root of the tongue), being thin, and rolled up like the spring of a watch.

The nest of the *Common Wasp* (*Vespa Vulgaris*) attracts more or less the attention of everybody; but its interior architecture is not so well known as it deserves to be for its singular ingenuity, in which it rivals even that of the *Hive Bee* (*Apis Mellifica*). In their general economy, the *Social* or *Republican Wasps* closely resemble the *Humble Bee* (*Bombus*), every colony being founded by a single female, who has survived the winter, to the rigours of which all her summer associates and working *Wasps* usually fall victims; nay, out of three hundred females which may be found in one vespiary or *Wasp's* nest, towards the close of the autumn, scarcely ten or a dozen survive till the ensuing spring, at which season they awake from their hybernal lethargy, and begin with ardour the labours of colonization. It may be interesting to follow one of these *Mother Wasps* through her several operations, in which she merits more the praise of industry, than the *Queen* of a *Bee-hive*; who does nothing, and never moves without a numerous train of obedient retainers, always ready to execute her commands and do her homage. The *Mother Wasp*, on the contrary, is at first alone, and is obliged to perform every species of drudgery herself. Her first care, after being roused to ac-

tivity by the returning warmth of the season, is to discover a place suitable for her intended colony; and accordingly in the spring, *Wasps* may be seen prying into every hole of a hedge-bank, particularly where field mice have burrowed. In case of need, the *Wasp* is abundantly furnished by nature with instruments for excavating a burrow out of the solid ground, as she no doubt most commonly does; digging the earth with her strong mandibles, and carrying it off, or pushing it out as she proceeds. The entrance gallery is about an inch or less in diameter, and usually runs in a winding or zigzag direction from one to two feet in depth. In the chamber to which this gallery leads, and which, when completed, is from one to two feet in diameter, the *Mother Wasp* lays the foundation of her city, beginning with the walls.

The building materials employed by *Wasps* were long a matter of conjecture to scientific enquirers, for the bluish grey papery substance of the whole structure, has no resemblance to any sort of wax employed by *Bees* for a similar purpose. Now that the discovery has been made, we can with difficulty bring ourselves to believe (says Rennie) that a naturalist so acute and indefatigable as Réaumur, should have for twenty years, as he tells us, endeavoured without success, to find out the secret. At length, however, his perseverance was rewarded. He remarked a female *Wasp* alight on the sash of his window and begin to gnaw the wood with her mandibles, and it struck him at once that she was procuring materials for building. He saw her detach from the wood a bundle of fibres about a tenth of an inch in length, and finer than a hair; and as she did not swallow these but gathered them into a mass with her feet, he could not doubt that his first idea was correct. In a short time she shifted to another part of the window-frame, carrying with her the fibres she had collected, and to which she continued to add, when he caught her in order to examine the nature of her bundle, and he found that it was not yet moistened nor rolled into a ball, as is always done before employing it in building. In every other respect it had precisely the same colour and fibrous texture as the walls of a vespiary. It struck him as remarkable, that it bore no resemblance to wood gnawed by other insects, such as the *Goat Moth Caterpillar*, which is granular like sawdust. This would not have suited the design of the *Wasp*, who was well aware that fibres of some length form a stronger texture.

He even discovered that before detaching the fibres she bruised them (*les charpissoit*) into a sort of lint (*charpie*) with her mandibles. All this the careful naturalist imitated by bruising and paring the same wood of the window-sash with his pen-knife, till he succeeded in making a little bundle of fibres scarcely to be distinguished from that collected by the *Wasp*. The bundles of ligneous fibres thus detached, are moistened before being used with a glutinous liquid, which causes them to adhere together, and are then kneaded into a sort of paste or *papier maché*. Having prepared some of this material, the *Mother Wasp* begins first to line with it the roof of her chamber (for *Wasps* always build downwards). The round ball of fibres, which she has previously kneaded up with

glue, she now forms into a leaf, walking backwards and spreading it out with her mandibles, her tongue and her feet, till it is as thin almost as tissue paper. One sheet, however, of such paper as this would form but a fragile ceiling, quite insufficient to prevent the earth from falling down into the nest. The *Wasp*, accordingly, is not satisfied with her work till she has spread fifteen or sixteen layers one above the other, rendering the wall altogether near two inches thick. The several layers are not placed in contact like the layers of a piece of pasteboard, but with small intervals or open spaces between, appearing somewhat like a grotto built with bivalve shells, particularly when looked at on the outside. This is probably caused by the insect working in a curvilinear manner. Having first finished the ceiling, she next begins to build the first terrace of her city, which under its protection she suspends horizontally, and not like the combs in a *Bee-hive*, in a perpendicular position. The suspension of which we speak, is also light and elegant, compared with the more heavy union of the *Hive-bees* combs. It is in fact a hanging-floor, immoveably secured by rods of similar materials with the roof, but rather stronger. From twelve to thirty of these rods, about an inch or less in length, and a quarter of an inch or less in width, and a quarter of an inch in diameter, are constructed for the suspension of the terrace. They are elegant in form, being made gradually narrower towards the middle and widening at each end, in order, no doubt, to render their hold the stronger. The terrace itself is circular and composed of an immense number of cells formed of the paper already described, and of almost the same size and form as those of a honey-comb; each being a perfect hexagon, mathematically exact, and every hair's breadth of the space completely filled. These cells, however, are never used as honey pots by *Wasps*, as they are by *Bees*; for *Wasps* make no honey, and the cells are wholly appropriated to the rearing of their young. Like other *Hymenopterous* insects, the *Grubs* are placed with their head downwards, and the opening of the cells are also downwards, while their united bottoms form a nearly uniform level upon which the inhabitants of the nest may walk.

We have seen, says Rennie, when a young *Bee* had escaped from its cradle cell, and so rendered it empty, that cell was subsequently appropriated to the storing of honey. But in the case of *Wasps*, a cell thus evacuated is immediately cleaned out and repaired for the reception of another *Grub*, an egg being laid in it by a *Female Wasp*, as soon as it is ready. When the *Foundress Wasp* has completed a certain number of cells and deposited eggs in them, she soon intermits her building operations, in order to procure food for the young *Grubs*, which now require all her care. In a few weeks these become perfect *Wasps*, and lend their assistance in the exterior of the edifice, enlarging the original coping of the foundress by side walls, and forming another platform of cells, suspended to the first by columns, as that had been suspended to the ceiling. In this manner several platform of combs are constructed,

the outer walls being extended at the same time, and by the end of the summer there is generally from twelve to fifteen platforms of cells. Each contains about 1,060 cells, forty-nine being contained in an inch and a half square, and of course making the enormous number of about 16,000 cells in one colony. Réaumur, upon these data, calculates that one vespiary may produce every year more than 30,000 *Wasps*, reckoning only 10,000 cells, and each serving successively for the cradle of three generations. But although the whole structure is built at the expense of so much labour and ingenuity, it has scarcely been finished before the winter sets in, when it becomes nearly useless, and serves only for the abode of a few benumbed females, who abandon it on the approach of spring, and never return, for *Wasps* do not, like *Mason Bees*, ever make use of the same nest for more than one season.

Both Réaumur and the younger Huber studied the proceedings of the *Common Wasp* in the manner which has been so successful in observing *Bees*—by means of glazed hives and other contrivances. In this these naturalists were greatly aided by the extreme affection of *Wasps* for their young ; for though their nest is carried off, or even cut in various directions and exposed to the light, they never desert it, nor relax their attention to their progeny. When a *Wasp's* nest is removed from its natural situation and covered with a glass hive, the first operation of the inhabitants is to repair the injuries it has suffered. They carry off with surprising activity all the earth or other matter which has fallen by accident into the nest; and when they have got it thoroughly cleared of everything extraneous, they begin to secure it from further derangement by fixing it to the glass with papyraceous columns, similar to those which we have already described. The breaches which the nest may have suffered are then repaired, and the thickness of the walls is augmented, with the design, perhaps, of more effectually excluding the light.

It may not be out of place to relate a curious instance of the hardihood (if I may so call it) of the *Wasp*. One of these insects was crawling up a window, when a lady seized it with a pair of scissors with the intention of killing it, but by accident cut it in two ; the *Wasp* was no longer thought of for some time, but the lady happening by chance to look at it, thought the two parts had approached nearer each other ; it was then watched, and after being separated for three or four hours they gradually joined ; it then rested for a few minutes, and the parts appeared to be as firmly fixed as before the accident had happened, it then crawled up the window and flew away. This may be relied on as a fact.*

Third Lecture.

Although the HIVE BEE (*Apis Mellifica*) has engaged the attention of the curious from the earliest ages, recent discoveries prove that we

* J. B. B.

are yet only beginning to arrive at a correct knowledge of its wonderful proceedings. Pliny informs us, that Aristomachus, of Soles in Cilicia, devoted fifty-eight years to the study ; and that Philiscus, the Thracian, spent his whole life in forests for the purpose of observing them. But in consequence (as we may naturally infer) of the imperfect methods of research, assuming that what they did discover was known to Aristotle, Columella, and Pliny, we are justified in pronouncing the statements of these philosophers, as well as the embellished poetical pictures of Virgil, to be nothing more than conjecture, almost in every particular erroneous. It was not indeed till 1712, when glass hives were invented by Maraldi, a mathematician at Nice, that what we may call the in-door proceedings of *Bees* could be observed. This important invention was soon afterwards taken advantage of by Réaumur, who laid the foundation of the more recent discoveries of John Hunter, Schirach, and the Hubers.

The admirable architecture which *Bees* exhibit in their miniature cities, has by these and other naturalists been investigated with great care and accuracy. It had long been known that the *Bees* of a hive consist of three sorts, which were ascertained by Réaumur to be distinguished as workers or neuters, constituting the bulk of the population, drones or males the least numerous class, and a single female the queen and mother of a colony. Schirach subsequently discovered the very extraordinary fact, which Huber and others have proved beyond doubt, that when a hive is accidentally deprived of a queen, the *Grub* of a worker is fed in a particular manner, so as to become a queen and supply the loss. But another discovery of Huber is of more importance : by minute research, he ascertained that the workers which had been considered by former naturalists to be all alike, are divided into two important classes, nurse *Bees* and wax makers. The nurse *Bees* are rather smaller than the wax workers, and even when gorged with honey their belly does not, as in the others, appear distended. Their business is to collect honey and impart it to their companions, to feed and take care of the young *Grubs*, and to complete the combs and cells which have been founded by the others ; but they are not charged with provisioning the hive. The wax workers, on the other hand, are not only a little larger, but their stomach when gorged with honey is capable of considerable distension, as Huber proved by repeated experiments. He also ascertained, that neither of the species can alone fulfil all the functions shared among the workers of a hive. He painted those of each class with different colours, in order to study their proceedings, and their labours were not interchanged. In another experiment, after supplying a hive deprived of a queen with brood and pollen, he saw the nurse *Bees* quickly occupied in the nutrition of the *Grubs*, while those of the wax working class neglected them ; when hives are full of combs, the wax workers disgorge their honey into the ordinary magazines, making no wax ; but if they want a reservoir for its reception, and if their queen

does not find cells ready-made wherein to lay her eggs, they retain the honey in the stomach, and in twenty-four hours they produce wax. Then the labour of constructing combs begins. It might, perhaps, be supposed, that when the country does not afford honey, the wax workers consume the provision stored up in the hive; but they are not permitted to touch it. A portion of honey is carefully preserved, and the cells containing it are protected by a waxen covering which is never removed, except in cases of extreme necessity, and when honey is not otherwise to be procured. The cells are at no time opened during summer, other reservoirs always exposed contribute to the daily use of the community; each *Bee*, however, supplying itself from thence with nothing but what is required for present wants. Wax workers appear with large bellies at the entrance of their hive only, when the country affords a copious collection of honey. From this it may be concluded, that the production of the waxy matter depends on a concurrence of circumstances not invariably subsisting. Nurse *Bees* also produce wax, but in a very inferior quantity to what is elaborated by the real wax workers. Another characteristic whereby an attentive observer can determine the moment of *Bees* collecting sufficient honey to produce wax, is the strong odour of both these substances from the hive, which is not equally intense at any other time. From such data it was easy for Huber to discover whether the *Bees* worked in wax in his own hives and in those of the other cultivators of the district. There is still another sort of *Bees* first observed by Huber in 1809, which appear to be only casual inmates of the hive, and which are driven forth to starve or are killed in conflict. They closely resemble the ordinary workers, but are less hairy, and are of a much darker colour. These have been called *Black Bees*, and supposed by Huber to be defective *Bees*; but Kirby and Spence conjecture that they are toil-worn superannuated workers of no further use; and are therefore sacrificed because burdensome to a community which tolerates no unnecessary inmates. The very great numbers of *Black Bees*, however, which sometimes appear does not well accord with such an opinion; the subject remains therefore still in uncertainty. The notion commonly entertained respecting glass hives, is altogether erroneous. Those who are unacquainted with *Bees* imagine, that by means of a glass hive all their proceedings may easily be watched and recorded; but it is to be remembered, that *Bees* are exceedingly averse to the intrusion of light, and their first operation in such cases is to close up every chink by which light can enter to disturb them, either by clustering together, or by a plaster composed of propolis. It consequently requires considerable management and ingenuity, even with the aid of a glass hive to see them actually at work. Huber employed a hive with leaves, which opened in the manner of a book, and for some purposes he used a glass box inserted in the body of the hive, but easily brought into use by means of screws. But no invention hitherto contrived is sufficient to obviate every difficulty.

The *Bees* are so eager to afford mutual assistance, and for this purpose so many of them crowd together in rapid succession, that the operation of individuals can seldom be traced. Though this crowding, however, appears to an observer to be not a little confused, it is all regulated with admirable order, as has been ascertained by Réaumur and other distinguished naturalists. When *Bees* begin to build the hive, they divide themselves into bands, one of which produces materials for the structure ; another works upon these, and forms them into a rough sketch of the dimensions and partitions of the cells. All this is completed by the second band, who examine and adjust the angles, remove the superfluous wax, and give the work its necessary perfection, and a third band brings provisions to the labourers who cannot leave their work. But no distribution of food is made to those whose charge in collecting propolis and pollen calls them to the field, because it is supposed they will hardly forget themselves ; neither is any allowance made to those who begin the architecture of the cells. Their province is very troublesome, because they are obliged to level and extend as well as cut and adjust the wax to the dimensions required ; but then they soon obtain a dismissal from this labour, and retire to the fields to regale themselves with food and wear off their fatigue with a more agreeable employment. Those that succeed them draw their mouth, their feet, and the extremity of the body several times over all the work, and never desist till the whole is polished and completed ; and as they frequently need refreshments and yet are not permitted to retire, there are waiters always attending who serve them with provisions when they require them. The labourer who has an appetite bends down his trunk before the *Caterer*, to intimate that he has an inclination to eat, upon which the other opens his bag of honey and pours out a few drops, these may be distinctly seen rolling through the whole of his trunk, which insensibly swells in every part that the liquor flows through. When this little repast is over, the labourer returns to his work, and his body and feet repeat the same motions as before. Before they can commence building, however, when a colony or swarm migrates from the original hive to a new situation, it is necessary first to collect propolis, with which every chink and crevice in the place where they mean to build may be carefully stopped up ; and secondly, that a quantity of wax be secreted by the wax-workers to form the requisite cells. The secretion of wax, it would appear, goes on best when the *Bees* are in a state of repose, and the wax-workers accordingly suspend themselves in the interior in an extended cluster like a curtain, which is composed of a series of intertwined festoons or garlands, crossing each other in all directions ; the uppermost *Bee* maintaining its position by laying hold of the roof with its fore legs, and the succeeding one, by laying hold of the hind legs of the first. A person says, Réaumur must have been born devoid of curiosity not to take interest in the investigation of such wonderful proceedings. Yet Reaumur himself seems not to have understood that the *Bees* suspended themselves in this manner to secrete

wax, but merely, as he imagined, to recruit themselves by rest for renewing their labours. The *Bees* composing the festooned curtain, are individually motionless, but this curtain is notwithstanding kept moving by the proceedings in the interior, for the nurse *Bees* never form any portion of it and continue their activity; a distinction with which Réaumur was unacquainted. Although there are many thousand labourers in a hive, they do not commence foundations for combs in several places at once; but wait till an individual *Bee* has selected a site and laid the foundation of a comb, which serves as a directing mark for all that are to follow. Were we not so expressly told by so accurate an observer as Huber, we might hesitate to believe that *Bees*, though united in what appears to be an harmonious monarchy, are strangers to subordination and subject to no discipline. Hence it is, that though many *Bees* work on the same comb they do not appear to be guided by any simultaneous impulse. The stimulus which moves them is successive. An individual *Bee* commences each operation, and several others successively apply themselves to accomplish the same purpose; each *Bee* appears, therefore, to act individually, either as directed by the *Bees* preceding it, or by the state of advancement in which it finds the work it has to proceed with. If there be any thing like unanimous consent, it is the inaction of several thousand workers, while a single individual proceeds to determine and lay down the foundation of the first comb. Réaumur regrets, that though he could by snatches detect a *Bee* at work in founding cells, or perfecting their structure, his observations were generally interrupted by the crowding of other *Bees* between him and the little builder. He was, therefore, compelled rather to infer the different steps of their procedure, from an examination of the cells when completed, than from actual observation.

The ingenuity of Huber even under all the disadvantages of blindness succeeded in tracing the minutest operations of the workers from the first waxen plate of the foundation. I think the narrative of the discoverer's experiments as given by himself, will be more interesting than any abstract of it. Having taken a large bell-shaped glass receiver, we glued their wooden slips to the arch at certain intervals, because the glass itself was too smooth to admit of the *Bees* supporting themselves on it. A swarm consisting of some thousand workers, several hundred males and a fertile queen was introduced, and they soon ascended to the top; those first gaining the slips fixed themselves there by the fore feet, others scrambling up the sides joined them by holding their legs with their own, and they thus formed a kind of chain fastened by the two ends to the upper parts of the receiver, and served as ladders or a bridge to the workers enlarging their number; the latter were united in a cluster, hanging like an inverted pyramid from the top to the bottom of the hive. The country then affording little honey, we provided the *Bees* with syrup of sugar, in order to hasten their labour; they crowded to the edge of a vessel containing it, and having satisfied themselves,

returned to the group. We were now struck with the absolute repose, of the hive contrasted with the usual agitation of *Bees*: meanwhile the nurse *Bees* alone went to forage in the country, they returned with pollen, kept guard at the entrance of the hive, cleansed it, and stopped up its edges with propolis. The wax-workers remained motionless above fifteen hours; the curtain of *Bees* consisting always of the same individuals, assured us that none replaced them. Some hours later we remarked, that almost all these individuals had wax scales under the wings, and next day this phenomenon was still more general. The *Bees* forming the external layer of the cluster, having now somewhat altered their position, enabled us to see their bellies distinctly. By the projection of the wax scales the wings seemed edged with white; the curtain of *Bees* became rent in several places, and some commotion began to be observed in the hive. Convinced that the combs would originate in the centre of the swarm, our whole attention was then directed towards the roof of the glass; a worker at this time detached itself from the crowd, and with its head drove away the *Bees* at the beginning of the row in the middle of the arch, turning round to form a space, an inch or more in diameter, in which it might move freely: it then fixed itself in the centre of the space thus cleared. The worker now employing the pincers at the joint of one of the third pair of its limbs, seized a scale of wax projecting from a ring and brought it forward to its mouth with the claws of its fore legs, where it appeared in a vertical position. We remarked, that with its claws it turned the wax in every necessary direction, that the edge of the scale was immediately broken down, and the fragments having been accumulated in the hollow of the mandibles, issued forth like a very narrow ribbon, impregnated with a frothy liquid by the tongue. The tongue itself assumed the most varied shapes, and executed the most complicated operations, being sometimes flattened like a trowel, and at other times pointed like a pencil, and after imbuing the whole substance of the ribbon, pushed it forward again into the mandibles, whence it was drawn out a second time, but in an opposite direction. At length the *Bee* applied these particles of wax to the vault of the hive, where the saliva impregnating them, promoted their adhesion, and also communicated a whiteness and opacity which were wanting when the scales were detached from the rings. Doubtless this process was to give the wax that ductility and tenacity belonging to its perfect state. The *Bee* then separated with its mandibles those portions not yet applied to use, and with the same organs afterwards arranged them at pleasure. The founder *Bee*, a name appropriated to this worker, repeated the same operations, until all the fragments worked up and impregnated with the fluid were attached to the vault, when it repeated the preceding operations on the part of the scale yet kept apart, and again united to the rest what was obtained from it. A second and a third scale were similarly treated by the same *Bee*, yet the work was

only sketched, for the worker did nothing but accumulate the particles of wax together; meanwhile the founder, quitting its position, disappeared amidst its companions; another with wax under the rings succeeded it, which suspending itself to the same spot, withdrew a scale by the pincers of the hind legs and passing it through its mandibles prosecuted the work; and taking care to make its deposit in a line with the former, it united their extremities; a third worker detaching itself from the interior of the cluster, now came and reduced some of the scales to paste, and put them near the materials accumulated by its companions, but not in a straight line. Another *Bee*, apparently sensible of the defect, removed the misplaced wax before our eyes, and carrying it to the former heap, deposited it there exactly in the order and direction pointed out. From all these operations was produced a block, of a rugged surface hanging down from the arch without any perceptible angle, or any traces of cells; it was a simple wall or ridge running in a straight line, and without the least inflection, two-thirds of an inch in length; about two-thirds of a cell or two lines high, and declining towards the extremities. We have seen other foundation walls from an inch to an inch and a half long, the form being always the same, but none ever of greater height. The vacuity in the centre of the cluster had permitted us to discover the first manœuvres of the *Bees*, and the art with which they laid the foundations of their edifices; however, it was filled up too soon for our satisfaction, for workers collecting on both faces of the wall, obstructed our view of their further operations.

All the species of *Ants* are social. There are some solitary, as in the case with *Bees* and *Wasps*. They are all more or less skilful in architecture: some employing masonry, and others being carpenters, wood-carvers, and miners. They consequently afford much that is interesting to naturalists who observe their operations. The genuine history of *Ants* has only been recently investigated; first by Gould in 1747, and subsequently by Linnæus, De Geer, Huber, and Latreille. Previous to that time their real industry and their imagined foresight were held up as moral lessons without any great accuracy of observation; and it is probable that even now the mixture of truth and error, in Addison's delightful papers in the *Guardian* (No. 156, 157), may be more generally attractive than the minute relations of careful naturalists. Gould disproved, most satisfactorily, the ancient fable of *Ants* storing up corn for winter provision, no species of *Ants* ever eating grain, or feeding in winter upon anything. It is to Huber the younger, however, that we are chiefly indebted for our knowledge of the habits and economy of *Ants*, and to Latreille for a closer distinction of the species. Some of the more interesting species, whose singular economy is described by the younger Huber, have not hitherto been found in this country. M. Latreille discovered a species of *Ants* which were, so far as he could ascertain, completely blind, and of course it would be immaterial to them

whether they worked by night or during the day. All observers, indeed, agree that *Ants* labour in the night, and a French naturalist is of opinion that they never sleep ; a circumstance which is well ascertained with respect to other animals, such as the *Shark*, which will track a ship in full sail for weeks together. The ingenious historian of *English Ants*, Gould, says they never intermit their labours by night or by day, except when compelled by excessive rains. It is probable the ancients were mistaken in asserting that they only work when the moon shines ; for like *Bees* they seem to make no difficulty in building in the dark, their subterranean apartments being as well furnished as the upper stories of their buildings.

The BROWN ANT (*Formica Brunnea*), one of the smallest of the *Ants*, is particularly remarkable for the extreme finish of its work. Its body is of a reddish shining colour. The abdomen is of an obscure brown, the scale narrow, of a square form, and slightly scalloped. This *Ant*, one of the most industrious of its tribe, forms its nest of stories four or five lines in height, (a line is the twelfth part of an old French inch). The partitions are not more than half a line in thickness, and the substance of which they are composed is so finely grained, that the inner walls present one smooth unbroken surface. These stories are not horizontal, they follow the slope of the *Ant-hill*, and lie one upon another to the ground-floor, which communicates with the subterranean lodges. They are not, however, always arranged with the same regularity, for these *Ants* do not follow an invariable plan ; it appears on the contrary that nature has allowed them a certain latitude in this respect, and that they can, according to circumstances, modify them to their wish ; but, however fantastical their habitations may appear, they are always observed to have been formed by concentric stories. On examining each story separately, we observe a number of cavities or halls, lodges of narrower dimensions, and long galleries, which serve for general communication. The arched ceilings, covering the most spacious places, are supported either by little columns, slender walls, or by regular buttresses. There are also chambers that have but one entrance communicating with the lower story, and large open spaces, serving as a kind of cross-road, in which all the streets terminate. Such is the manner in which the habitations of these *Ants* are constructed. Upon opening them the apartments are commonly found, as well as the large open spaces, filled with adult *Ants*, and we always observe their *pupæ* more or less near the surface. This, however, seems regulated by the hour of the day and the temperature, for in this respect these *Ants* are endowed with great sensibility, and know the degree of heat best adapted for their young. The *Ant-hill* contains sometimes more than twenty stories in its upper portion, and at least as many under the surface of the ground. By this arrangement the *Ants* are enabled with the greatest facility to regulate the heat. When a too burning sun overheats their upper apartments, they withdraw their little ones to the bottom of the

Ant-hill. The ground floor becoming in its turn uninhabitable during the rainy season, the *Ants* of this species transport what most interests them to the higher stories, and it is there they are found more usually assembled with their eggs and pupæ, when the subterranean apartments are submerged. *Ants* have a great dislike to water when it exceeds that of a light shower to moisten their building materials. One species, mentioned by De Azara, as indigenous to South America, instinctively builds a nest from three to six feet high to provide against the inundations during the rainy season. Even this, however, does not always save them from submersion; and when that occurs, they are compelled, in order to prevent themselves from being swept away, to form a group somewhat similar to the curtain of the wax-workers of *Hive-bees*. The *Ants* constituting the basis of this group lay hold of some shrub for security, while their companions hold on by them, and thus the whole colony, forming an animated raft, floats on the surface of the water till the inundation (which seldom continues longer than a day or two) subsides.

- It is usual with architectural insects to employ some animal secretion by way of mortar or size to temper the materials with which they work, but the whole economy of *Ants* is so different, that it would be wrong to infer from analogy a similarity in this respect, though the exquisite polish and extreme delicacy of finish in their structures lead naturally to such a conclusion. Huber, in order to resolve this question, at first thought of subjecting the materials of the walls to chemical analysis, but wisely abandoned it for the surer method of observation. The details which he has given as the result of his researches are exceedingly curious and instructive. He began by observing an *Ant-hill* till he could perceive some change in its form. The inhabitants, says he, of that which I selected, kept within during the day, or only went out by subterranean galleries which opened at some feet distance in the meadow. There were, however, two or three small openings on the surface of the nest, but I saw none of the labourers pass out this way on account of their being too much exposed to the sun, which these insects greatly dread. This *Ant-hill*, which had a round form, rose in the grass at the border of a path, and had sustained no injury. I soon perceived that the freshness of the air and the dew invited the *Ants* to walk over the surface of their nest; they began by making new apertures: several of the *Ants* might be seen arriving at the same time, thrusting their heads from the entrances, and at length adventuring forth to visit the environs. This brought to my recollection a singular opinion of the ancients. They believed that *Ants* were occupied in their architectural labours during the night when the moon was at its full. Having noticed the movements of these insects during the night, I found they were always abroad and engaged about the dome of their habitation after sunset. This was directly the reverse of what I had observed in the conduct of the *Wood Ants* (*Formica rufa*), who only go out during the day, and close their

doors in the evening. The contrast was still more remarkable than I had previously supposed, for upon visiting the *Brown Ants* some days after during a gentle rain, I saw all their architectural talents in full play. As soon as the rain commenced they left in great numbers their subterranean residence, re-entered it almost immediately, and then returned bearing between their teeth pellets of earth, which they deposited on the roof of their nest. I could not at first conceive what this was meant for, but at length I saw little walls start up on all sides, with spaces left between them. In several places columns ranged at regular distances announced halls, lodges, and passages, which the *Ants* proposed establishing; in a word, it was the rough beginning of a new story. I watched with a considerable degree of interest the most trifling movements of my masons, and found that they did not work after the manner of *Wasps* and humble *Bees* when occupied in constructing a covering to their nest. The latter sit as it were astride on the border or margin of the covering, and take it between their teeth to model, and attenuate it according to their wish. The wax of which it is composed, and the paper which the *Wasp* employs, moistened by some kind of glue, are admirably adapted for the purpose; but the earth of which the *Ants* make use, from its often possessing little tenacity, must be worked up after some other manner. Each *Ant* then carried between its teeth the pellet of earth it had formed by scraping with the end of its mandibles the bottom of its abode, a circumstance which I have frequently observed in open day. This little mass of earth being composed of particles but just united, could be readily kneaded and moulded as the *Ants* wished; thus, when they had applied it to the spot where they had to rest, they divided and pressed against it with their teeth so as to fill up the little inequalities of their wall. The antennæ followed all their movements, passing over each particle of earth as soon as it was placed in its proper position. The whole was rendered more compact by pressing it lightly with the fore feet. This work went on remarkably fast. After having traced out the plan of their masonry in laying here and there foundations for the pillars and partitions they were about to direct, they raised them gradually higher by adding fresh materials. It often happened that two little walls, which were to form a gallery, were raised opposite and at a slight distance from each other. When they had attained the height of four or five lines, the *Ants* busied themselves in covering in the space left between them by a vaulted ceiling. As if they judged all their partitions of sufficient elevation, they then quitted their labours in the upper part of the building; they affixed to the interior and upper part of each wall, fragments of moistened earth in an almost horizontal direction, and in such a way as to form a ledge which by extension would be made to join that coming from the opposite wall. These ledges were about half a line in thickness, and the breadth of the galleries was for the most part about a quarter of an inch. On one side several vertical partitions were seen to form the scaffolding of a lodge, which communicated with several

corridors by apertures formed in the masonry, on another a regularly formed hall was constructed, the vaulted ceiling of which was sustained by numerous pillars; further off again might be recognized the rudiments of one of those cross-roads of which I have before spoken, and in which several avenues terminate. These parts of the *Ant-hill* were the most spacious; the *Ants*, however, did not appear embarrassed in constructing the ceiling to cover them in, although they were often more than two inches in breadth. In the upper part of the angles formed by the different walls, they laid the first foundations of this ceiling, and from the top of each pillar, as from so many centres, a layer of earth, horizontal and slightly convex, was carried forward to meet the several portions coming from different points of the large public thoroughfare. I sometimes, however, laboured under an apprehension that the building could not possibly resist its own weight, and that such extensive ceilings, sustained only by a few pillars, would fall into ruins, from the rain which continually dropped upon them; but I was quickly convinced of their stability, from observing that the earth brought by these insects adhered at all points on the slightest contact, and that the rain so far from lessening the cohesion of its particles, appeared even to increase it. Thus, instead of injuring the building, it even contributed to render it still more secure. These particles of moistened earth, which are only held together by juxta position, require a fall of rain to cement them more closely, and thus varnish over, as it were, those places where the walls and galleries remain uncovered. All inequalities in the masonry then disappear. The upper part of these stories, formed of several pieces brought together, presents but one single layer of compact earth. They require for their consolidation nothing but the heat of the sun. It sometimes, however, happens, that a violent rain will destroy the apartments, especially should they be but slightly arched, but under these circumstances the *Ants* re-construct them with wonderful patience. These different labours were carried on at the same time, and were so closely followed up in the different quarters, that the *Ant-hill* received an additional story in the course of seven or eight hours. All the vaulted ceilings being formed upon a regular plan, and at equal distances, from one wall to the other, constituted, when finished, but one single roof. Scarcely had the *Ants* finished one story than they began to construct another, but they had not time to finish it, the rain ceasing before the ceiling was fully completed. They still, however, continued their work for a few hours, taking advantage of the humidity of the earth, but a keen north wind soon sprung up and hastily dried the collected fragments, which no longer possessing the same adherence fell into powder. The *Ants* finding their efforts ineffectual, were at length discouraged; but what was my astonishment when I saw them destroy all the apartments that were yet uncovered scattering here and there over the last story, the materials of which they had been composed. These facts incontestibly prove that they employ neither gum nor any kind of cement



Diptera.
Tipula Crocata.



Aptera.
Aranea Aquatica. [Water Spider.]

to bind together the several substances of their nest, but in place of this avail themselves of the rain to work or knead the earth, leaving the sun and wind to consolidate it.

My own observations tend to confirm some of the statements which I have related. I put some *Ants* of the yellow species (*Formica flava*) into a large glass bottle, that I might watch their proceedings underground; and I had likewise obtained some of the *Black Ants* (*Formica rufa*), which I likewise placed in the same situation. For the first two or three days no work was carried on; at the end of that time the top of the mould which was placed in the bottle was covered with dead and dying of the black species; for the *Yellow Ants*, being in much larger numbers, had conquered the *Black Ants* and destroyed them. They then set about constructing galleries; for, unlike the species I have related above, they dig into the earth instead of raising chambers on the top of it. I have not been able to ascertain whether the *Ants* are totally blind, but I have reason to think that their *antennæ* or feelers answer the purpose of eyes; for, as I was watching them one day, I perceived that an *Ant* had lost one of its *antennæ*, and in consequence was proceeding very slowly, almost every second touching the earth with its remaining feeler, as if it had been totally blind. They proceeded very quickly in their work of excavating galleries, and made passages in every direction. In about a week after I had placed the first *Ants* in the bottle, I procured another quantity and put them on the top of the earth. A very curious circumstance then occurred, which, if I had not seen with my own eyes, I certainly should not have believed. One of the *Ants* had been accidentally cut in two, and I saw the legs and the head running about the mould evidently in search of its body. In about two hours it had been successful, for I saw it joining its body to its head and legs, and it then walked about with as much activity as the rest.*

DIPTERA. Few can have failed to remark that *Flies* walk with the utmost ease along the cieling of a room, and no less so upon a perpendicular looking-glass; and though this were turned downwards, the *Flies* would not fall off, but could maintain their position undisturbed with their backs hanging downwards. The conjectures devised by naturalists to account for this singular circumstance, previous to the ascertaining of the actual facts, are not a little amusing. Some suppose, says the Abbé de la Pluche, that when the *Fly* marches over any polished body on which neither her claws nor her points can fasten, she sometimes compresses her sponge, and causes it to evacuate a fluid, which fixes her in such a manner as prevents her falling, without diminishing the facility of her progress; but it is much more probable that the sponges correspond with the fleshy balls which accompany the claws of dogs and cats, and that they enable the *Fly* to proceed with a softer pace, and contri-

* J. B. B.

bute to the preservation of its claws, whose pointed extremities would soon be impaired without this prevention. Its ability to walk on glass, says Shaw, proceeds partly from some little ruggedness thereon, but chiefly from a tarnish or dirty smoky substance adhering to the surface ; so that though the sharp points on the sponges cannot penetrate the surface of the glass, it may easily catch hold of the tarnish. This is evidently borrowed from Hook ; but it is singular that none of these fanciers ever took the trouble to ascertain the existence of either a gluten squeezed out by the *Fly*, or of the smoky tarnish on glass. Even the shrewd Réaumur could not give a satisfactory explanation of the circumstance.

The earliest correct notion of this curious subject was entertained by Derham, who, upon mentioning the provision made for insects that hang on smooth surfaces, says, I might here name divers *Flies* and other insects who, besides their sharp hooked nails, have also skinny palms to their feet, to enable them to stick to glass and other smooth bodies by means of the pressure of the atmosphere, after the manner as I have seen boys carry heavy stones with only a wet piece of leather clapped on the top of the stone. The justly celebrated Mr. White, of Selborne, apparently without the aid of microscopical investigation, adopted Derham's opinion, adding the interesting illustration, that in the decline of the year, when the *Flies* crowd to windows and become sluggish and torpid, they are scarcely able to lift their legs, which seem glued to the glass, where many actually stick till they die ; whereas they are during warm weather so brisk and alert that they easily overcome the pressure of the atmosphere. The apparatus in the feet of the *Fly* consists of two or three membraneous suckers, connected with the last joint of the foot by a narrow neck, of a funnel shape, immediately under the base of each claw, and moveable in all directions. The suckers are covered above and hollow below the edges, being margined with minute serratures, and the hollow portion covered with down. In order to produce the vacuum and the pressure, these membranes are separated and expanded, and when the *Fly* is about to lift its foot, it brings them together and folds them up as it were between the two claws. By means of a common microscope these interesting movements may be observed when a *Fly* is confined in a wine glass.

The CHEQUERED BLOW FLY (*Sarcophaga Carnaria*) hatches its eggs in an abdominal pouch, and instead of eggs, depositing maggots upon dead carcases. The eggs of all *Flesh Flies* are in sultry weather hatched with great rapidity ; but in the case of the *Chequered Blow Fly*, nature has provided the means of still more rapid destruction for removing the offensive part of carcases. The arrangement of the numerous minute larvæ in the pouch is very remarkable, and resembles the coil of a watch-spring, or a roll of ribbon. Réaumur had the patience and perseverance to uncoil the multitudinous assemblage of *Flies* in embryo, and found it about two inches and a half in length, though the body of the *Mother*

Fly herself was only about one-third of an inch ; and he computed that there were about 20,000 young in the coil. When this extraordinary fecundity is considered, we need not wonder at the countless swarms which appear, as if by magic, upon a joint of meat during hot weather. Like most female insects, the *Mother Fly* dies in a few days after giving birth to her numerous brood ; but, unlike *Oviparous Flies*, she seems to take a considerable time to deposit the whole. It would be impossible, indeed, for her pouch to contain the larvæ if they were all hatched at the same time ; and therefore it has been so ordered by Providence that they should arrive at maturity in succession.

From the early death of the mother, Réaumur conjectured that they did not scruple to eat their way through her bowels ; but he disproved his supposition by a most decisive experiment. He took a *Fly*, which had already deposited a few larvæ, and closed the natural opening of the pouch with sealing-wax, so that it was impossible any more could make their exit there. The mother lived several days longer than she would have done had she been left at liberty to produce her young, but not one of them attempted to force a passage, after having been shut up for ten days.

The COMMON GNAT (*Culex Pipiens*) constructs a boat-shaped raft, which will float, of eggs heavy enough to sink in the water, if dropped into it one by one. The eggs are nearly of the pyramidal form of a gun-powder flask, rather pointed at the upper, and broad at the under end, with a projection like the mouth of a bottle.

The first operation of the *Mother Gnat* is to fix herself by the four fore legs to the side of a bucket, or upon a floating leaf, with her body level with and resting upon the surface of the water, excepting the last ring of the tail, which is a little raised ; she then crosses her two hind legs in form of an X, the inner opening of which is intended to form the scaffolding of her structure. She accordingly brings the inner angle of her crossed legs close to the raised part of her body, and places in it an egg covered, as is usual among insects, with a glutinous fluid. On each side of this egg she places another, all which adhere firmly together by means of their glue, and form a triangular figure, which is the stern of the raft. She proceeds in the same manner to add egg after egg in a vertical position, carefully regulating the shape by her crossed legs ; and as her raft increases in magnitude, she pushes the whole gradually to a greater distance, and when she has about half-finished she uncrosses her legs, and places them parallel ; the angle being no longer necessary for shaping the boat. Each raft consists of from two hundred and fifty to three hundred and fifty eggs, which, when all laid, float on the water secure from sinking, and are finally abandoned by the mother. They are hatched in a few days, the *Grubs* issuing from the lower end ; but the boat, now composed of empty shells, continues to float till it is destroyed by the weather,

Kirby justly describes this little vessel as resembling a London

wherry, being sharp and higher, as sailors say, fore and aft, convex below, and concave above, and always floating on its keel. The most violent agitation of the water, he adds, cannot sink it; and what is more extraordinary, and a property still a desideratum in our life-boats, though hollow, it never becomes filled with water, even though exposed. To put this to the test, says Kirby, I placed half a dozen of these boats upon the surface of the tumbler, half full of water; I then poured upon them a stream of that element from the mouth of a quart bottle, held a foot above them. Yet, after this treatment, which was so rough as actually to project one out of the glass, I found them floating as before upon their bottoms, and not a drop of water within their cavity.

APTERA. The WHITE ANTS, or *Termites*. Were our houses built in the same proportion as their nests, they would be twelve or fifteen inches higher than the Monument, and four or five times higher than the pyramids Egypt, with corresponding dimensions in the basements of the edifices. These statements are, perhaps, necessary to impress the extraordinary labours of *Ants* upon the mind for we are all more or less sensible to the force of comparisons. The analogies between the works of insects and of men are not perfect; for insects are all provided with instruments peculiarly adapted to the end which they instinctively seek, while man has to form a plan by progressive thought and upon the experience of others, and to complete it with tools which he also invents. The *termites* do not stand above a quarter of an inch high, while their nests are frequently twelve feet. Nor is it only in constructing dwellings for themselves that the *termites* of Africa and other hot climates, employ their masonic skill. Though like our *Ants* and *Wasps*, they are almost omnivorous, yet wood, particularly when felled and dry, seems their favorite article of food; but they have an utter aversion to feeding in the light, and always eat their way with all expedition into the interior. It thence would seem necessary for them either to leave the bark of a tree, or the outer portion of the beam or door of a house undevoured, or to eat in open day. They do neither, but are at the trouble of constructing galleries of clay in which they can conceal themselves and feed in obscurity. In all their foraging excursions, indeed they build covert ways, by which they can go out and return to their encampment. Others of the species (for there are several) instead of building galleries exercise the art of miners, and make their approaches under ground, penetrating beneath the foundation of houses or areas, and rising again either through the floors, or by entering the bottom of the posts that support the building, when they follow the course of the fibres, and make their way to the top, boring holes and cavities in different places as they proceed. Multitudes enter the roof and intersect it with pipes and galleries formed of wet clay, which serve for passages in all directions, and enable them more readily to fix their habitations in it. They prefer the softer woods, such as pine and fir, which they hollow out with such nicety that they leave the surface whole after having eaten

away the inside. A shelf or plank attacked in this manner, looks solid to the eye, when, if weighed, it will not out-balance two sheets of paste-board of the same dimensions. It sometimes happens, that they carry this operation so far on stakes in the open air, as to render the bark too flexible for their purpose ; when they remedy the defect by plastering the whole stick with a sort of mortar which they make with clay, so that on being struck, the form vanishes, and the artificial covering falls in fragments on the ground. In the woods, when a large tree falls from age or accident, they enter on the side next the ground, and devour it at leisure, till little more than the bark is left ; but in this case, they take no precaution of strengthening the outward defence, but leave it in such a state as to deceive an eye unaccustomed to see trees thus gutted of their insides, and you may as well, says Mr. Smeathman, step on a cloud. It is an extraordinary fact, that when these creatures have formed pipes in the roof of a house, instinct directs them to prevent its fall, which would ensue from their having sapped the posts on which it rests ; but as they gnaw away the wood, they fill up the interstices with clay, tempered to a surprising degree of hardness ; so that when the house is pulled down these posts are transformed from wood to stone. They make the walls of their galleries of the same composition as their nests, varying the materials according to their kind, one species using red clay, another black clay, and the third a woody substance, cemented with gums as a security from the attacks of their enemies, particularly the common *Ant*, which being defended by a strong horny shell, is more than a match for them, and when it can get at them, rapaciously seizes them and drags them to its nest for food for its young brood. If any accident breaks down part of their walls, they repair the breach with all speed, instinct guides them to perform their office in the creation, by mostly confining their attacks to trees that are beginning to decay, or such timber as has been severed from its root for use, and would decay in time. Vigorous healthy trees do not require to be destroyed, and accordingly these consumers have no taste for them.

A MASON SPIDER (*Mygale Cæmentaria*) found in the South of France, usually selects for her nest a place bare of grass, sloping in such a manner as to carry off the water, and of a firm soil, without rocks or small stones. She digs a gallery a foot or two in depth, and of a diameter (equal throughout) sufficient to admit of her easily passing. She lines this with a tapestry of silk glued to the walls. The door, which is circular, is constructed of many layers of earth kneaded and bound together with silk. Externally it is flat and rough, corresponding to the earth, around the entrance, for the purpose no doubt of concealment ; on the inside it is convex and tapestried thickly with a web of fine silk. The threads of this door tapestry are prolonged and strongly attached to the upper side of the entrance, forming an excellent hinge, which when pushed open by the *Spider* shuts again by its own weight, without the aid of spring hinges. When the *Spider* is at home and her

door forcibly opened by an intruder, she pulls it strongly inwards, and even when half open often snatches it out of the hand ; but when she is foiled in this, she retreats to the bottom of her den as her last resource. The Rev. Revett Shepherd has often noticed in the fen ditches of Norfolk a very large *Spider* (the species not yet determined), which actually forms a raft for the purpose of obtaining its prey with more facility. Keeping its station upon a ball of weeds about three inches in diameter, probably held together by slight silken cords, it is wafted along the surface of the water upon this floating island, which it quits the moment it sees a drowning insect. The booty thus seized, it devours at leisure upon its raft, under which it retires when alarmed by any danger. That *Spiders* may be able to breath under water, we can well understand from their breathing like amphibious reptiles by means of gills, but there is an aquatic spider (*Argyroneta aquatica*) which is not contented as a frog would be with the air furnished by the water, but actually carries down a supply of air from the atmosphere to her subaqueous nest. This *Spider* does not like stagnant water, but prefers slow running streams and ditches, where she may often be seen in the vicinity of London and elsewhere, living in her diving bell, which shines through the water like a little globe of silver, her singular economy was first described by Clerck and De Geer. The shining appearance, says Clerck, proceeds either from an inflated globule surrounding the abdomen, or from the space between the body and the water. The *Spider*, when wishing to inhale the air, rises to the surface with its body still submersed, and only the part containing the spinneret rising just to the surface, when it briskly opens and moves its four teats. A deep cone of hair keeps the water from approaching or wetting the abdomen. It comes up for air about four times an hour or oftener, though I have good reason to suppose it can continue without it for several days together. "I found in the middle of May," says Clerck, "one male and ten females, which I put into a glass filled with water, where they lived together very quietly for eight days. I put some duck weed (*Lemna*) into the glass to afford them shelter, and the females began to stretch diagonal threads in a confused manner from it to the sides of the glass, about half way down. Each of the females afterwards fixed a close bag to the edge of the glass, from which the water was expelled by the air from the spinneret, and thus a cell was formed capable of containing the whole animal. Here they remained quietly with their abdomens in their cells, and their bodies still plunged in the water ; and in a short time brimstone coloured bags of eggs appeared in each cell, filling it about a fourth part. On the 7th July, several young ones swam out from one of the bags, all this time the old ones had nothing to eat, and yet they never attacked one another, as other *Spiders* would have been apt to do."

I have now described some, though by no means all, of each order of insects, and I shall conclude with some observation regarding it as a

Study. It has been objected to by many, that it tends to withdraw the mind from subjects of higher moment, that it cramps and narrows the range of thought, and that it destroys or at least weakens the finer creations of the fancy. Now we should allow this objection in its fullest extent, and even be disposed to carry it further than is usually done, if the collecting of specimens only, or as the French expressively call them chips (*Echantillons*) be called a study. But the mere collector is not and cannot be justly considered as a naturalist; and taking the term naturalist in its enlarged sense, some distinguished instances can be adduced in opposition to the objection. Charles James Fox can be given as an illustrious example, and I may add the names of some of our distinguished poets, Goldsmith, Thompson, Gray, and Darwin, who were all enthusiastic naturalists. It may be new to some who are familiar with the elegy in a country church yard, to be told that its author was at the pains to turn the characteristics of the Linnæan order of insects into Latin Hexameters; the manuscript of which is still preserved in his interleaved copy of the *Systema Naturæ*. Further, to use the words of Kirby and Spence, whose work on Entomology is one of the most instructing and pleasing books on the Science, Aristotle among the Greeks, and Pliny the elder among the Romans, may be denominated the fathers of Natural History, as well as the greatest philosophers of their day; yet both these made insects a principal object of their attention. In more recent times, if we look abroad, what names are greater than those of Redi, Malpighi, Vallisnieri, Swammerdam, Leeuwenhoek, Réaumur, Linnæus, De Geer, Bonnet and the Hubers; and at home, what philosophers have done more good to their country and to human nature, than Ray, Willoughby, Lister, and Derham; yet all these made the study of insects one of their most favorite pursuits. A collection of insects is to the true naturalist, what a collection of medals is to the accurate student of history. The mere collector, who looks only to the shining wings of the one, or the green rust of the other, derives little knowledge from his pursuit; but the cabinet of the Entomologist becomes rich in the most interesting subjects of contemplation, when he regards it in the genuine spirit of scientific inquiry. What, for instance, can be so delightful as to examine the wonderful variety of structure in this portion of the creation, and above all to trace the beautiful gradations by which one species runs into another. Their differences are so minute, that an unpractised eye would proclaim their identity, and yet when the species are separated, and not very distantly, they become visible even to the common observer. It is in examinations such as these, that the naturalist finds a delight of the highest order. While it is thus one of the legitimate objects of his study to attend to minute differences of structure, form and colouring, he is not less interested in the investigation of habits and economy, and in this respect the insect world is inexhaustibly rich. We find herein examples of instinct to parallel those of all the larger animals,

whether they are solitary or social, and innumerable others besides, altogether unlike those manifested in the superior departments of animated nature. These instincts have various directions, and are developed in a more or less striking manner to our senses, according to the force of the motive, by which they are governed. Some of their instincts have for their object the preservation of insects from external attack; some have reference to procuring food, and involve many remarkable stratagems; some direct their social economy, and regulate the condition under which they live together, either in monarchies or republics, their colonizations and their migrations; but the most powerful instinct which belongs to insects has regard to the preservation of their species. We find accordingly, that as the necessity for this preservation is of the utmost importance in the economy of nature, so for this especial object many insects whose offspring, whether in the egg or larva state, are peculiarly exposed to danger, are endued with an almost miraculous foresight, and with an ingenuity, perseverance and unconquerable industry for the purpose of avoiding those dangers, which are not to be paralleled even by the most singular efforts of human contrivance. The same ingenuity which is employed for protecting either eggs, or *Caterpillars* and *Grubs*, or *Pupæ* and *Chrysalides* is also exercised by many insects, for their own preservation against the changes of temperature to which they are exposed, or against their natural enemies. Many species employ those contrivances during the period of their hybernation or winter sleep. For all these purposes, some dig holes in the earth and form them into cells; others build nests of extraneous substances, such as bits of wood and leaves; others roll up leaves into cases, which they close with the most curious art; others build a house of mud and line it with the cotton of trees, or the petals of the most delicate flowers; others form cocoons in which they undergo their transformation; and others dig subterraneous galleries, which in complexity of arrangement, in solidity, and in complete adaptation to their purposes, vie with the cities of civilized man.



